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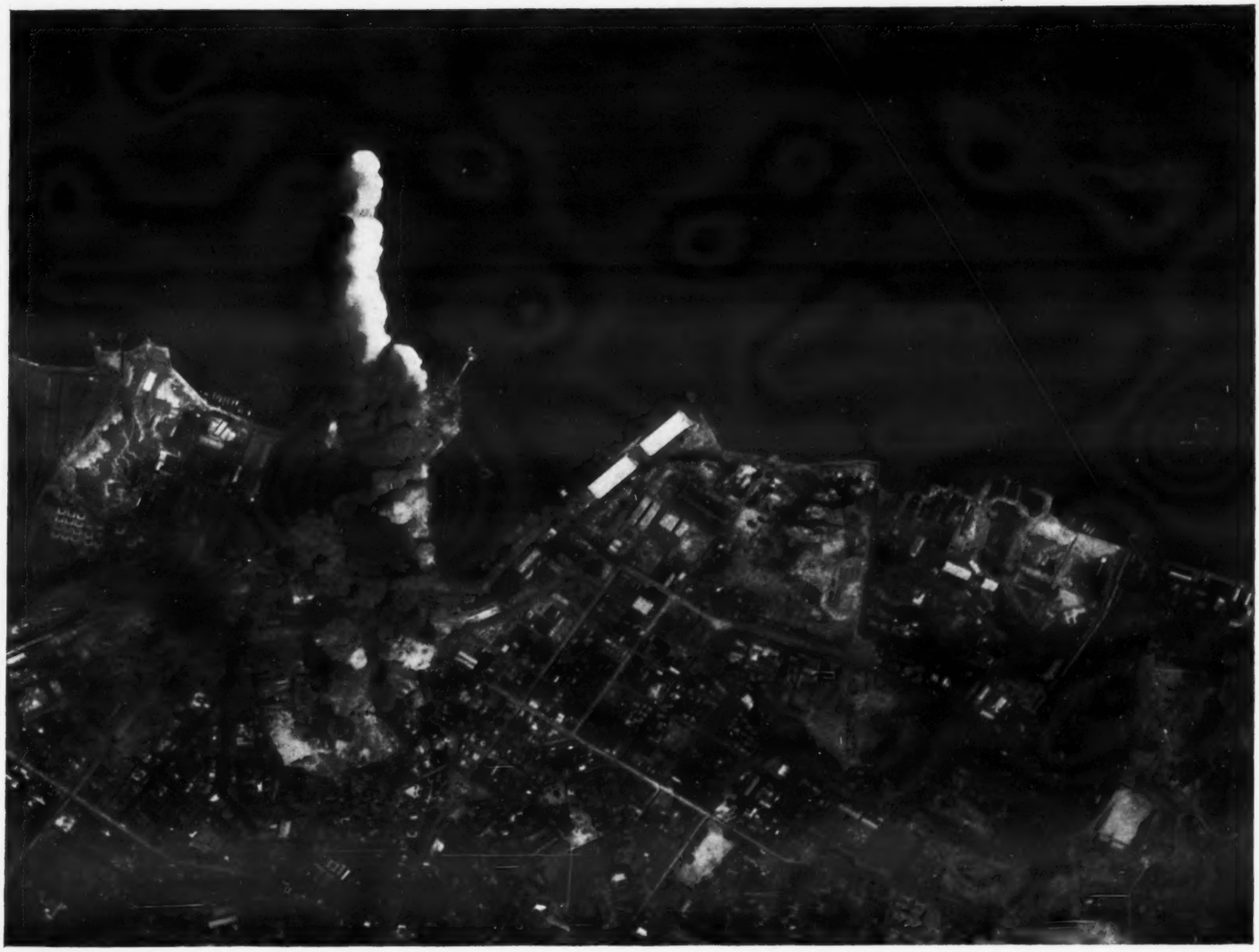

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Korean Commentary

VOLUME V 7 1950

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Front cover :

The U. S. A. F. bombs a Corean port.

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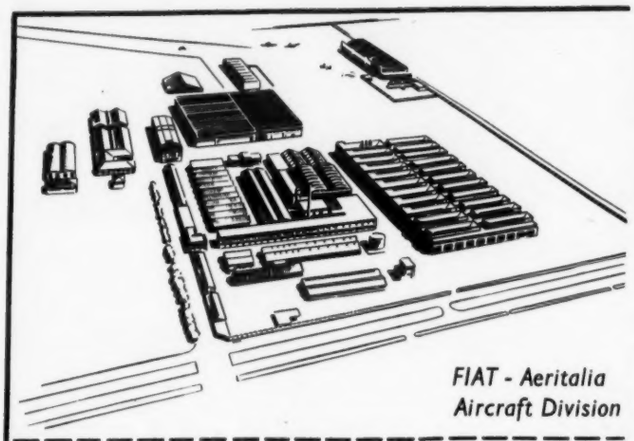

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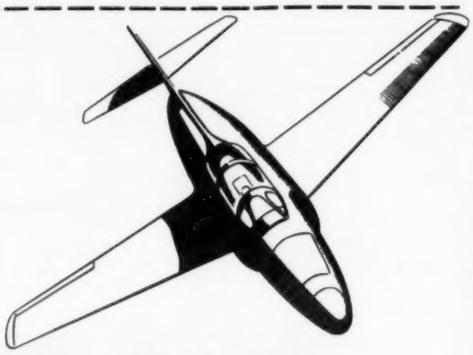

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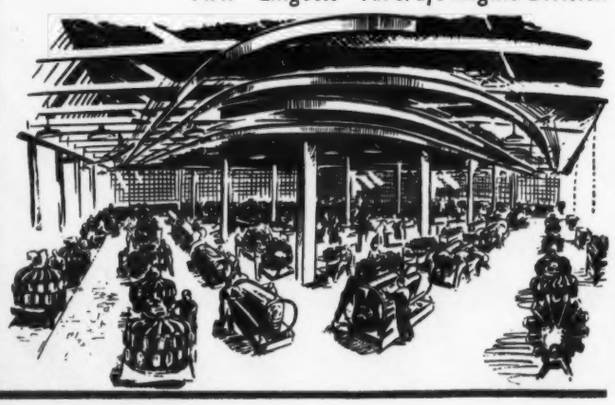

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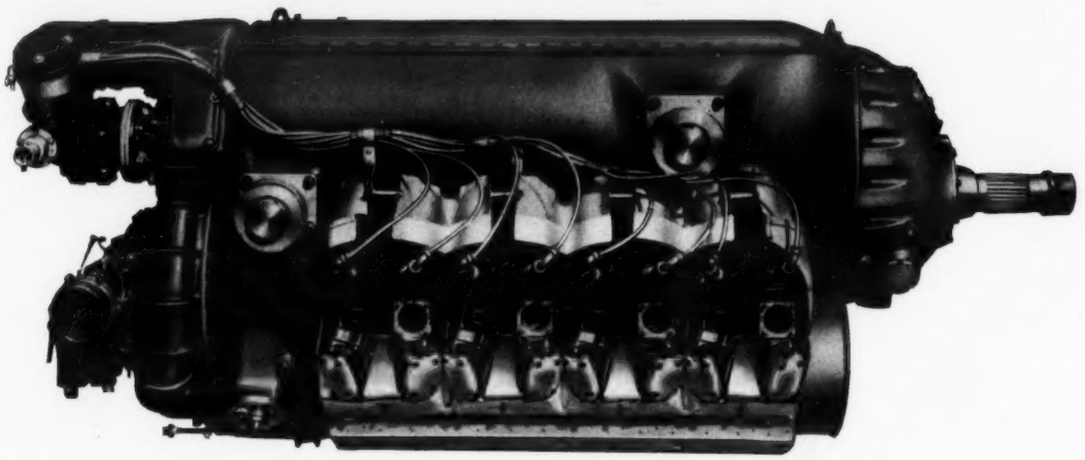

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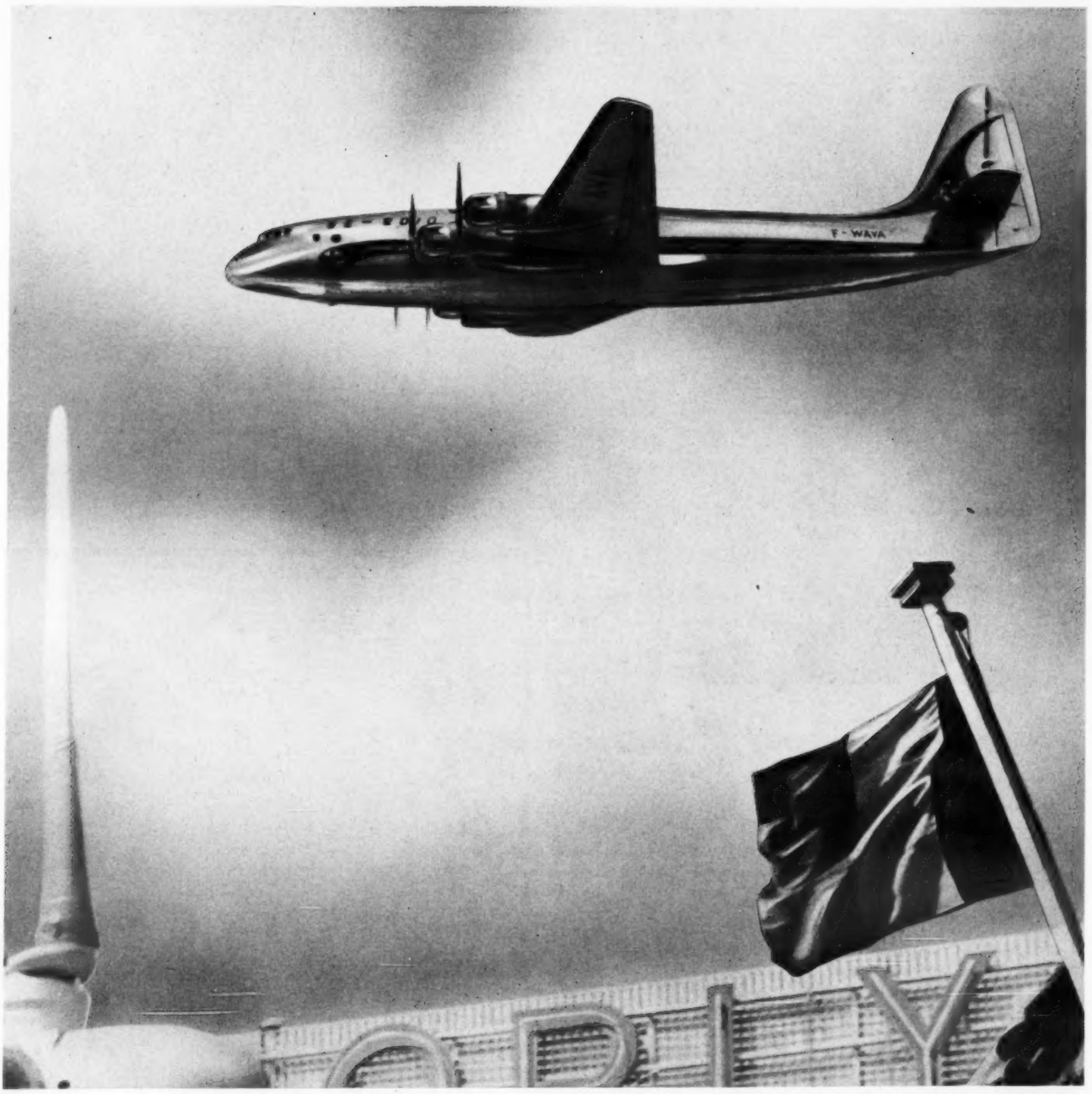

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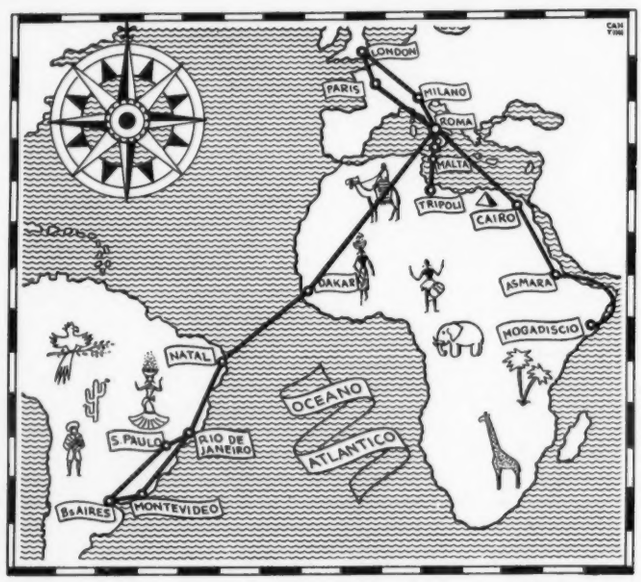

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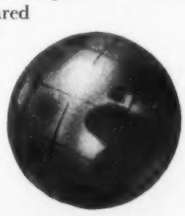

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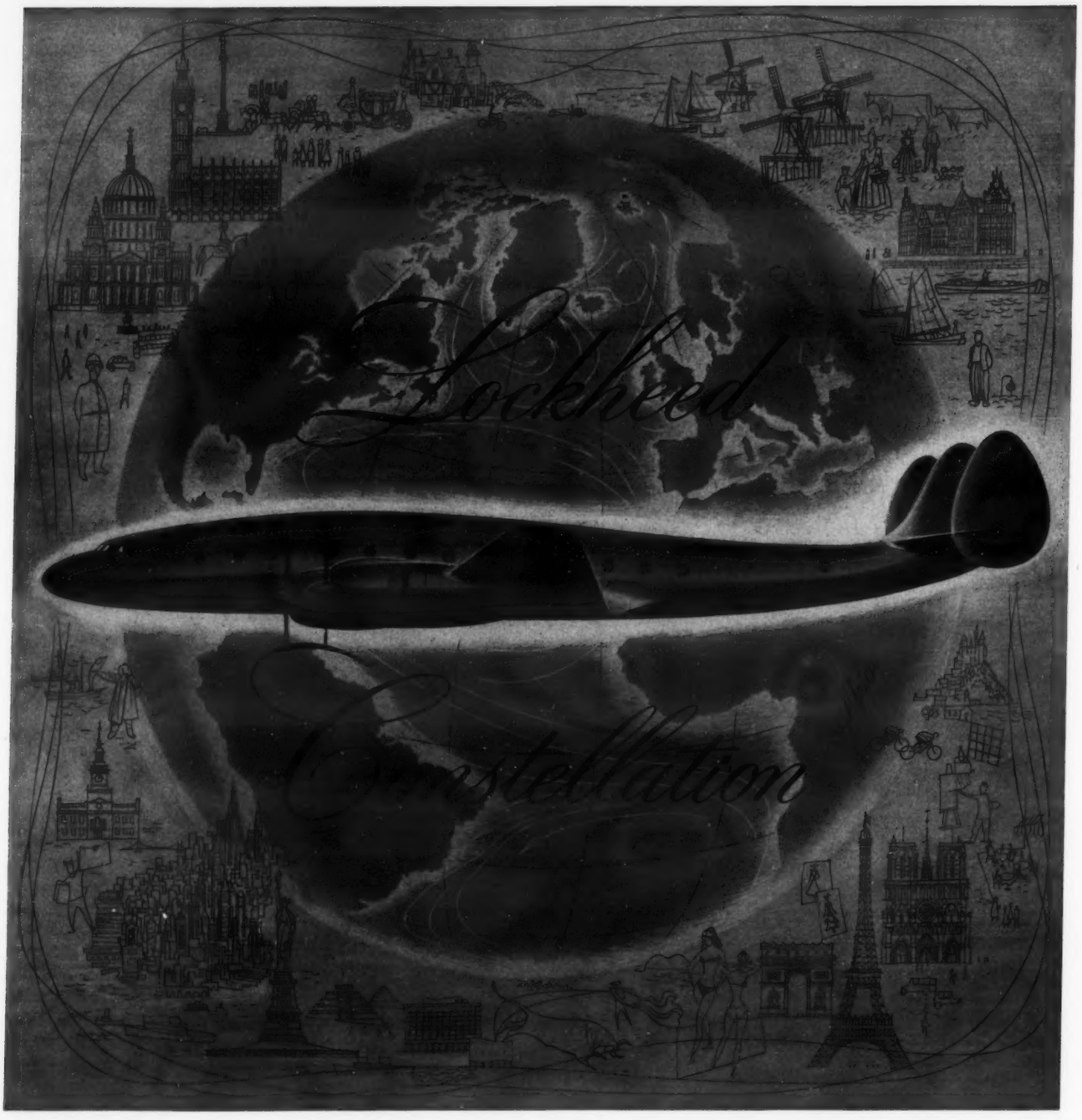

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Korean Commentary

BY MAJOR EDDY BAUER

On the morning of June 25th, 1950, the radio and the press informed the world that an armed conflict had broken out in Korea. The United Nations Security Council met and took position. American forces were sent to aid the South Korean Republic on behalf of the United Nations. The war communiqués of North and South Korea soon announced that air forces had gone into action on both sides. Since that date, the daily press of all the countries in the world has been full of news about the Korean War which continues unabated and sometimes threatens to assume larger proportions.

The military expert and the layman may be interested in a critical review of the events from the unbiased pen of a war commentator of renown. INTERAVIA REVIEW has turned to Professor Eddy Bauer, of Neuchâtel University, Major in the Swiss General Staff.

The author was born in Neuchâtel on April 4th, 1901. He studied philosophy at Neuchâtel University and history at the Ecole Nationale des Chartes in Paris, and in 1928 he obtained the diploma of Archiviste-Paléographe. Since October 1928 he has been Professor of History at Neuchâtel and has published several works dealing with the history of the Middle Ages. In 1937 and 1938, he went to various theatres of war as a correspondent for the French—Swiss press. Subsequently, he wrote a book called "Rouge et Or." From 1939 to 1945, Eddy Bauer was on active service with a Divisional General Staff of the Swiss Army. At the same time, he continued to write numerous military commentaries. In 1945, he was appointed Professor of Diplomatic History at the Military Section of the Swiss Federal Institute of Technology in Zurich. From his military studies emerged a 640-page book on armoured warfare, "La Guerre des Blindés" (Payot, Lausanne and Paris). He was Rector of Neuchâtel University from 1947 to 1949.

Eddy Bauer is a regular contributor to the "Revue Militaire Suisse" and the classical French review "Forces aériennes françaises." —ED.—

To do—or not to do

"War," the Prussian General Karl von Clausewitz has said, "is but a continuation of politics by other means." This dictum of the genius of modern strategy is so well-known that it nearly seems banal to quote it. Yet it is unusually characteristic of present happenings between the 38th Parallel and the Strait of Korea, and there is no doubt that it will exercise a decisive influence on the events in that area for many weeks to come. The leaders of American diplomacy probably will recognise the accuracy of Clausewitz's statement, although the people in the White House and the Pentagon Building in Washington did not foresee that it was about to be practically applied once again.

South Korean position on the line of demarcation along the 38th Parallel.

If Clausewitz had wanted to say that war emerges from peace like a bolt of lightning out of a cloud and that the dropping of bombs, the firing of shells, torpedoes, machine guns and other forms of unpleasantness are a logical sequel when the exchange of diplomatic notes proves unavailing, he would have expressed a platitude of the first order. He would not have earned the admiration of which he has been the object on the part of brilliant men in the 19th and 20th Centuries—including Karl Marx, Friedrich Engels and Nicolas Ulianov, better known as Lenin. The founder of the famous Berlin *Kriegsakademie* aimed both higher and farther. He endeavoured to convey the idea that a close inter-relationship inevitably exists between diplomatic exchanges and warlike methods and that the views of the statesman must regularly be coordinated with those of the military chief. It is easy to imagine what would happen if a diplomat engaged in delicate negotiations did not take into account the present situation and the immediate potential of his country's armed forces. The effect would be similar to that of a careless financier who, disregarding his cash position and assets, entered into new commitments. One might say that comparisons of this sort are easy. Granted—but Clausewitz was a witness of Prussia's collapse under Napoleon's blows on October 14th, 1806. Clausewitz had fully understood the traces which such errors have left on every page of the world's history book with tragic regularity.

The example which Washington has offered us since 1945 is no more edifying than that provided by Berlin in 1806. It is an open secret that the military leaders of the Pentagon—the Defence Department of the United States—never had any use for any diplomatic or political action

by the White House or the Far East Division of the US State Department. The *military chiefs* advised President Truman to order the evacuation of Korea as per January 1st, 1949. It was they who, until very recently, opposed the incorporation of Formosa into the American security zone. One is tempted to conclude from this systematic obstruction by the generals and admirals of the greatest Western Democracy that the American military chiefs are still clinging to an out-dated form of isolationism, the practical validity of which has long been refuted by world developments. Yet a reproach of this kind might be unfair.

Apart from that, this is not the point in question. After all, Generals Bradley, Collins and Vandenberg, plus Admiral Sherman, have been in a position to calculate the size of army, air force and naval units which would be required to turn the American guarantee of the integrity of Southern Korea into a military reality and not a mere scrap of paper with which America's leaders somewhat childishly hoped to impress the realists of the Kremlin. As professional soldiers, these military chiefs had the duty of basing their calculations on the most unfavourable eventuality, namely, a military emergency. This should be obvious —for one consults a doctor to obtain advice about an illness and a general to secure information about the possibilities of a war. On the assumption that the worst might happen, these generals should long ago have come to the conclusion that the USA did not possess the military might required it to deliver a shattering blow in reply to an attack launched by a Totalitarian hook-up. Worse still, they should have realised that neither Congress, nor the administration, nor public opinion was prepared to make a single one of the sacrifices which would be required to prepare an adequate defensive force within a useful period of time.

To revert to the case of Korea : on the eve of the North-Korean attack, the American Military Mission attached to the Government of South Korea totalled about 800 officers, non-commissioned officers and men. The forces under the command of South Korea's President Syngman Rhee consisted of lightly armed police suitable for jungle combat against Communist partisans or for frontier skirmishes. Military action on a vaster scale apparently was not considered probable. If it had been, the South Korean Government would have received military aid from President Truman similar to that granted to the Governments of Athens and Ankara. That such aid was not forthcoming was no doubt partly due to the unpleasant experiences the Americans had made with the Nationalist forces of China's Marshal Chiang Kai-shek which gave rise to the apprehension that in one way or another American war supplies shipped to South Korea would ultimately make their way into the hands of the Communist crowd of Pyong Yang.

Modern American "General Patton" tanks were ready for operations in the USA by July 14th and made a very belated arrival at the front.

Thus, the only forces to be counted upon were those of the United States. Things might have been different if a single Army Corps of four divisions, including an armoured division, had been shifted to Seoul at the beginning of the year. More than likely, nothing would have happened in the vicinity of the 38th Parallel. It is sad to note that the powerful democracy on the other side of the North Atlantic at the present time possesses no more than about ten and a half combat divisions (1), and it is not even sure whether these divisions are at full combat strength. If the necessary precautions had been taken, the Americans would have mobilised, armed and equipped at least 100,000 men, shipped them across the Pacific and stationed then permanently in an area which it takes about three weeks to reach by sea. Such an army of occupation would have needed an adequate tactical air support force of at least 300 or 400 fighter aircraft, fighter-bombers and attack-bombers. This would have required an additional strength of 20,000 to 30,000 men charged with the task of maintaining a modest air striking force and of protecting and operating a series of tactical air bases in South Korea. Since the only suitable air base was too far distant from the 38th Parallel to be of any use in the frontier fighting, the Americans should have shipped construction materials and machines across the Pacific on a scale sufficient to remedy the situation.

Now an effort of this sort is by no means beyond the possibilities of the Americans, whose foresight and industrial genius not long ago amazed the world, including the Russians and the Germans, namely when the Americans fought for a decision in the late war between November 8th, 1942, and May 8th, 1945. There is no cause to worry, even at present : given three months' time, the Americans will perform even greater miracles. But what about the present ? It is clear that the White House and the State Department were completely misinformed about the resources of the Seoul Government if they assumed that this government would be able to withstand the North Korean assault until the arrival of American reinforcements. The South Korean forces collapsed within three or four days.

Those responsible for America's foreign policy may argue that the insufficient military and financial effort of the American nation to prevent the conflict resulted to a large extent from the American generals' and admirals' patent inability to agree on a clear-cut strategy. It was these senior officers who allowed the equipment left over from the last war to rot because they laboured under the illusion that the atomic bomb was the cureall for all such evils in the future. There is more than a grain of truth in such arguments. Unforgotten are those stormy debates which led to the ousting of the stubborn Admiral Denfeld and to the cancellation, after five days of work, of the contract for the 65,000-ton aircraft carrier "United States" (2). Be that as it may, since the use of the atomic bomb is still supposed to depend upon certain political prerequisites, it is incomprehensible that nobody in the United States was struck by the necessity of building up a conservative, conventional military establishment not entirely dependent on uranium, plutonium or hydrogen.

It is no secret that only 800 modern tanks were ordered and built in the United States in 1949, sufficient to equip six normal combat units, and that military aircraft production was less than 200 aircraft of all types per month. It is true that the army still has 18,000 or 19,000 tanks, but the great majority of them are of the *Sherman* type, a model which was already obsolete at the end of World War II. Furthermore, the US Navy still possesses about 102 aircraft carriers of all types, but on June 25th, 1950, when war flared up in Korea, only 19 carriers were on active service, five of them in the Pacific.

[1] On June 25th, 1950, the USA had the following first-line divisions : 4 ½ in the Continental USA, two in Germany, four in Japan.

[2] Heavy four-engined bombers could have operated from the aircraft "United States," including "Rato"-equipped Boeing B-50 "Superfortresses." Another aircraft which should have been capable of taking off from the vessel would have been the six-engined Boeing B-47 "Stratojet."

American wounded in the Korean theatre of war.

"*As you make your bed you lie on it...*"

This old saying would apply if those who were put to sleep for ever by the North Korean T 34 tanks had been identical with those who had made their beds by using sheets which were too short and old, moth-eaten and torn blankets. Unfortunately, this is not the case and, with a few exceptions, has never been the case.

A first lesson thus emerges from this disastrous trial of strength. War is no game of poker, and it is not always possible to stay out of the scrap. For the Americans it would evidently have been even more unfavourable not to react to the Pyong Yang Government's well-planned attack than to counter it with insufficient numbers, insufficient preparation and insufficient equipment. These considerations lead one to the platitude that free and peace-loving people have always done well by keeping their powder dry, for they will never know the day, the hour, nor even the month when they will have to pay for their sins of omission.

It had been President Truman's original intention to send only air units to the aid of the South Korean forces. But when the situation deteriorated hour by hour, General MacArthur was ordered to take a direct hand in the defence of the country and to use the American forces of occupation in Japan for the purpose. Altogether these forces consisted of 123,500 officers, NCO's and men, making up four divisions :

First Cavalry Division,	Twenty-fourth Infantry Division,
Seventh Infantry Division,	Twenty-fifth Infantry Division.

It would obviously have been desirable to prepare a methodical deployment of these forces, covered by the South Korean allies, and then to throw two or three divisions into battle simultaneously once the situation had been stabilised. However, the miserable collapse of Syngman Rhee's forces compelled the glorious victor of the late war against the Japanese to shift everything on legs to the front and to disperse the troops of the 24th Infantry Division along an extended front. First to go into action was a battalion of the 34th Infantry Regiment, which was shortly followed by another battalion. A week later, the Army communiqués issued in Tokyo reported that the 19th Infantry Regiment had joined in the fighting, but it was not until July 17th that the entire 24th Infantry Division went into action under the command of Major-General William F. Dean (since reported missing in action).

What is the significance of this development ? Simply that it takes more than three weeks to move about 20,000 American soldiers with seventy-two 4-in. and 6-in. guns and a tank battalion of 71 medium tanks and three companies of 22 armoured cars each (3) across the Strait of Tushima.

The total strength of caterpillar track vehicles bearing US insignia which could be thrown into battle against the North Korean troops therefore amounted to 137. It is true that on July 18th it was announced that the van of the First Cavalry Division of Major-General Hobart R. Gay and of the 25th Infantry Division of Major-General William Kean had landed west of Pusan, but it will probably take several days before these units will be able to take an active hand at the front and reinforce the battle-weary 24th Infantry Division. Many things can happen in the interval.

What about the enemy ? The army of North Korea grew out of elements which left their homeland when the Japanese marched into Manchuria in 1932 and since then have formed part of the Soviets' Far East Army Group. As a component of this army group, they took part in the great battles of World War II. The North Korean forces therefore consist of well-trained professional soldiers totalling 100,000 men or more. Since the US Army communiqué had mentioned the North Korean 15th Division as the unit with the highest numerical designation, one may cautiously assume, on condition that there is no gap in the numerical enumeration, that the few Americans now in Korea are opposed by 150,000 fanatically fighting, well-trained Communists. Added to these must be a "Fifth Column," which makes it necessary for the Americans to take precautions about which their adversaries do not have to worry. These partisans should not be underestimated. Born and bred in the country, content with a bowl of rice collected from the "liberated" population, they do not require complicated supply lines, apart from ammunition and fuel. Accordingly, they are more or less immune from the activities of the American air force units.

As regards the armoured forces at the disposal of the North Koreans, it is clear that the American intelligence services in Tokyo completely underestimated the numerical strength of the tanks supporting the aggression of the Pyong Yang Government. It was announced the other day that 82 % of the T 34 tanks of the North Korean army had perished with their crews as a result of the fire directed against them by the American bazookas and the tactical air forces. The Reds, in spite of these crushing losses, imperturbably continued their offensive from the river Han to the river Kum. The result was that while on June 25th, 1950, the number of tanks operated by the North Koreans was re-estimated at 150, this figure was subsequently revised to 400. The mileage counter of one of the rare tanks captured by the 24th Infantry

[a] No transport fleet was available in Japanese waters when the war broke out. Transportation of a single armoured division requires about 250,000 tons of shipping space.

Aircraft-carrier "Valley Forge" of the US Navy, with 27 fighters and 32 attack bombers.

Boeing B-29 "Superfortresses" flying over Korea.

Division showed a total of 500 miles, which seems to indicate Pyong Yang is currently being supplied with brand new equipment which left the factories only just before hostilities broke out in Korea. Apart from that, it may be wise to regard certain figures and statistics with caution, a lesson already taught by the late war : a man fallen in battle is a soldier killed and buried with military honors, and a tank is only destroyed if it is literally blown up. We certainly do not doubt the reports of the American pilots. But if a tank is reported immobilised as the result of a bomb explosion, who can guarantee that it will not be fully mobile again 48 hours later after the necessary repairs have been effected ? Two damaged T 34's can be turned into a new T 34 in the same period of time. Did not the French labour under the same illusion in June 1940 on the banks of the Somme and the Aisne ?

General MacArthur's war communiqués now report that on July 18th the North Koreans had lost 11,000 men, and those who have seen the film "Stalingrad" which was shot to glorify the Red Army will consider such losses as credible. One of the fundamental principles of Russian tactics continues to be that of the massed attack, staggered in depth and covered by armoured forces. It is evident that the lives of three out of seven men are liable to be lost as a result of artillery and machine-gun fire. But the four survivors will probably succeed in killing the sole defender, and the defence can thus be pierced.

Lieutenant-General Walton H. Walker has now been appointed Commanding-General of the US Eight Army in Korea, and he will shortly have at his disposal three divisions, or about 60,000 men, and at least 400 tanks. As a result, the forces engaged should gradually become roughly equal.

Appearances and Reality

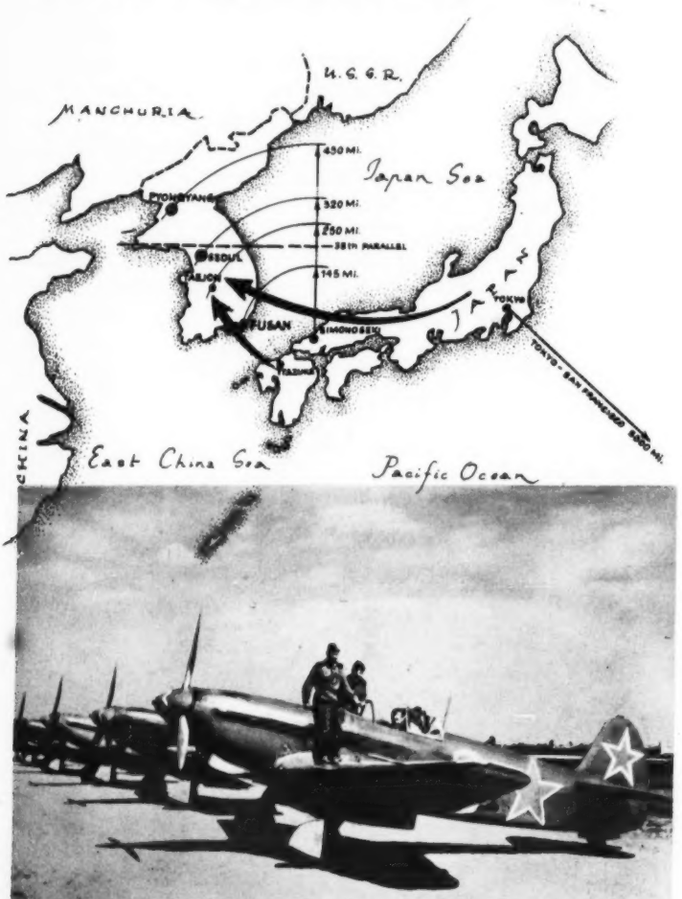
A few war reporters filled their cables with tactical and technical commentaries of the weapons employed along the river Kum. Most of them were absurd. At this writing, on July 20th, 1950, the conflict in Korea has been going on for 25 days and it is an undeniable fact that the outbreak of hostilities was a complete surprise to the Americans and immediately was succeeded by a second unpleasant surprise in the form of the South Korean collapse. Under such dramatic conditions the defenders went into battle with improvised means and, owing to the urgency of the matter, on some occasions a little carelessly. These circumstances should be kept in mind when assessing certain war reports which no doubt have so far afforded little pleasure to the American Generals.

This applies particularly to reports about the impotence of the US Air Force against the Russian-built T 34 tanks and about the manner in which the Soviet tanks rapidly outfought the American armour in Korea. Reports of this kind must be corrected. They remind me of a friend of my youth, an undergraduate of the Ecole des Chartes in Paris, who sat for his examinations in 1928. The examining professor, a famous scientist, pointed a warning finger, waved his glasses, and maliciously commented on the young man's thesis : "It contains good ideas and new ideas ; unfortunately, the good ideas are not new and the new ideas are not good." Let us stay with this comparison, with the "new ideas which are not good," i.e., with the pessimistic evaluation of the quality of the US air forces and their low efficacy in combat against the enemy's tanks. Let us emphasise the modest strength of the air forces at General MacArthur's disposal on the day of his surprise. On that date, June 25th, 1950, the following units were distributed between Guan Island and the airfields in Japan :

Guam : 1 Boeing B-29 "Superfortress" Group : 30 aircraft.
Japan : 2 Douglas B-26 "Invader" twin-engined light-bomber groups : 32 aircraft.
1 North American F-82 "Twin Mustang" twin-engined fighter group : 24-36 aircraft.
5 Lockheed F-80 "Shooting Stars" jet fighter groups : 325-375 aircraft.

This makes a total strength of between 411 and 473 first line aircraft, so far as it can be gleaned from the contradictory reports cabled from American headquarters in Tokyo. On the day of the surprise attack, the USAF's Far Eastern Air Force was under the command of Lieutenant-General George E. Stratemeyer.

The units of the US Air Force are supplemented by aircraft operating from aircraft carriers in Korean waters : 27 fighters and 32 attack bom-



Russian-built Yak 9 fighters, standard equipment of the North Korean Air Force.

A Lockheed F-80 "Shooting Star" jet fighter is being fitted with anti-tank rockets on an airfield in Japan.

The Lockheed F-80 "Shooting Star" fighters must be equipped with wing-tip tanks to enable them to fly from their base at Itazuke to the theatre of operations.

bers aboard the "Valley Forge" of the US Navy and 24 aircraft aboard the "Triumph" of the Royal Navy. A few days after the outbreak of hostilities a squadron of North American F-51 "Mustang" fighters of the Royal Australian Air Force arrived in Japan and first went into action with fighter-bombing and machine-gun attacks on a detachment of the US 24th Division in the area of Suwon.

Here a remark seems to be indicated. The "air support" forces originally available were most unsuited to the role of providing tactical support to the ground forces. There is no doubt that the thirty four-engined "Superfortresses" based on Guam are an effective strategic instrument in view of their long range and their bomb-load of about 10 tons. But it is difficult to see against what targets they can be used with any degree of efficiency in Korea apart from the important cities of Seoul and Pyong Yang. One may argue that, during World War II, the four-engined Boeing B-17 "Flying Fortress" bombers of the US Eighth Air Force and the four-engined "Avro-Lancasters" of Royal Air Force Bomber Command rendered valuable services also in the support of the Normandy landings in July, 1944. We do not wish to deny this, but we must recall that the strategic situation was absolutly clear at the time and that it was the Americans and the British who determined place and time of that decisive battle. All the same, and despite all precautions, tragic bombing errors occurred. The Army communiqués of General MacArthur, time and again contain the statement that the situation was in a "state of flux" and "extremely confused." In order to differentiate between friend and foe, the great four-engined aircraft of Lieutenant-General Stratemeyer would therefore have to fly at altitudes much below anything approaching their effective operating level.

Paradoxically, the first reinforcements arriving from the United States consisted of aircraft of this class. Around July 4th, the 22nd and the 92nd Bomber Groups of the USAF (about 75 Boeing B-29 aircraft) were alerted and arrived in the theatre of operations nine days later—giving proof of the splendid organization and operational mobility of these units. Nearly every day since their arrival in the Far East, i.e. for a little more than a week, they have dropped between 400 and 500 tons of bombs on Seoul, Pyong Yang and other communications centres. But it will take at least another month before the enemy will begin to feel the effects of these attacks. It is true that by June 6th, 1944, the beginning of the Normandy invasion, all the roads and railroad tracks in France were interrupted at thousands of points. But it should not be overlooked that the aerial softening-up process in preparation for the invasion had started in the first days of March. Furthermore, the government of Pyong Yang does not possess any arms factories of importance. Hence the Americans are unable to stop the flow of T 34 tanks and Yak 9 fighters by destroying their production centres but have to blow them up one by one in mobile warfare on the ground or in the air. This requires aircraft other than the "Superfortresses."

In this connection the tactical value of the Lockheed F-80 "Shooting Star" jet fighter has suddenly become the subject of heated controversy. Two facts are certain : at cruising speed and equipped with jetisonable wing tanks, this proven fighter has a range of 1,100 miles. But its range is offset by the distances the fighters have to cover to reach the fighting area :

Simonoski—Pusan	140 miles
Simonoski—Taejon	250 miles
Simonoski—Seoul	320 miles
Simonoski—38th Parallel	340 miles
Simonoski—Pyong Yang	450 miles

This means that a "Shooting Star" which during the initial phase of the conflict took off from Simonoski in Japan had only about ten or twenty minutes at its disposal to search and attack the small targets in the battle zone. Conditions have paradoxically improved for the Americans due to the fact that the enemy has advanced southwards towards Pusan by about 100 miles and has thus come within the normal range of American fighter aircraft. Again it should be recalled that in Normandy the "Mustang," "Thunderbolt" and "Typhoon" fighters combating the German armoured formations operated at a distance of only about 110 miles from base. All the same, the organization of the USAF has not lost its efficiency in Korea. Within a few days, airfield construction and engineering units of the USAF Fifth Air Force crossed the

US light anti-aircraft guns protecting a forward airfield.

Strait of Tushima, built an airfield called "Cleveland" somewhere in South Korea within four days and began to operate from it on July 14th.

The Lockheed "Shooting Star" jets have a cruising speed of about 550 m.p.h. which is now claimed to make the type worthless for ground attack purposes. No doubt these claims are exaggerated, but they do imply another question : are the air crews trained to carry out the complicated and multifarious duties of *tactical air support* of the ground forces ? Were these fighter pilots not trained for operations at high altitudes, for interception and destruction of enemy bombers ? Quite suddenly they are required to attack small targets on the ground from low level, such as tanks. And no doubt in order to help them, patrols of "Piper Cub" or similar aircraft have recently been placed under the command of the fighter units and given the task of seeking out the targets.

Beyond all doubt, the Americans were able to muster only a few squadrons of Douglas B-26 "Invader" and North American F-82 "Twin Mustang" twin-engine light and fighter bombers to support the operations of the 24th Infantry Division. Taking into account the assistance provided by a small number of Australian and carrier-borne aircraft, one comes to the conclusion that the Americans are operating a maximum of about 150 tactical aircraft of various types. Figures announced for the sorties flown by American and Australian air forces in Korea confirm this claim. A comprehensive report covering the events between June 26th and July 10th mentions a total of 1,570 sorties, representing a daily average of 104 missions (4). On July 12th the US Far Eastern Air Force flew 150 sorties, which increased to 250 two days later. But on July 15th the weather deteriorated, reducing operations to 190 missions. Although comparisons are nearly always misleading, it seems necessary to recall the strength at the disposal of the Americans and British during the days of heavy fighting in Normandy and the Ardennes :

July 18th, 1944, south of Caen	1,700 heavy bombers, 400 medium bombers ;
July 28th, 1944, at Saint-Gilles	1,800 heavy bombers, 500 fighters, 900 medium bombers, 500 fighter bombers ;
December 24th, 1944, in the Ardennes	5,012 sorties !

The question which sets itself is whether one has the right in the present case to speak of a failure of the Air Force in combating armoured ground forces. It seems to us that the situation is different : the Russian-built T 34 tanks of the North Korean Army simply owed their initial successes to the weakness of US tactical air support. Penicillin is prescribed by doctors in millions of units every day. Must it be declared useless because it may happen to fail in the case of a single patient suffering from pneumonia ? In any case, Lieutenant-General Bayerlein, now forcibly retired, former commander of the famous *Panzerlehr-division* in Normandy, would never subscribe to such a view. He would probably remind those who today seek to ridicule the effectiveness of air-borne anti-tank operations of his own experience : between June 6th and July 25th, on the occasion of the break-through of Saint-Gilles, seven drivers were killed by air attack in the lead tanks he occupied.

It is fortunate that the American higher command is not easily influenced by the amateur criticisms of certain reporter. On the contrary it is continuously reinforcing its air formations in Korea. True, this takes time. The North American F-51 "Mustang" fighters which have been in "mothballs" for years must be overhauled and shipped from the US West Coast to the war theatre, since their range does not permit their being flown across. And on July 12th the aircraft carrier "Boxer" left the United States with a full load of "Mustangs." In view of the high speed of the carrier (32 knots), this cargo should arrive in South Korea in good time. But the men in the Pentagon will bitterly regret not having had a single squadron of piston-engined fighters in the Pacific, apart from those operated by the carrier "Valley Forge," which will not be withdrawn from operations in the near future.

There is another subject which should briefly be alluded to, namely that of military air transportation and air-borne troops. On the day on which war broke out in Japan, a single group of 36 Douglas C-54 "Skymaster" four-engine transports was stationed in Japan. On the other side of the ocean the situation does not seem to have been any better, for the Washington Government had to order the requisitioning of 63 four-engined transports operated by the civil airlines. These aircraft have already rendered substantial services to General MacArthur. They were used to provide the troops fighting on the front with the new super-bazookas which were so urgently needed in the ruins of Taejon. It should not be forgotten that San Francisco is separated from Yokohama by 5,000 miles and 20 days of surface travel. Furthermore, the new rocket weapons and recoilless guns are of considerable interest in the fighting in the Far East, for owing to their light weight they can be loaded aboard aircraft together with an adequate quantity of ammunition.

On May 8th, 1945, the day on which the war in Europe came to an end, the Americans possessed five airborne divisions in all theatres, namely the Eleventh, Thirteenth, Seventeenth, Eighty-Second and 101st. This force has since been demobilized like the rest of the Army. Their equipment has been placed in storage. In our view, the Washington Government has committed a grave error by disbanding this corps of crack troops, exceedingly well trained in every form of warfare. One or two divisions of this type would have injected considerable vigor in General MacArthur's strategy and given it an elasticity which it completely lacks to-day. Let us also recall the prodigious exploits of the British Major-General Orde Wingate and his air-borne Chindits in the Burmese jungles. Those in control apparently considered that the maintenance of such an instrument of war would be particularly expensive, and for this reason it was dropped. In effect, it required 2,355 transport aircraft and 867 gliders to carry three divisions of this type

The aircraft-carrier "Boxer" under way from San Francisco to Japan. The vessel is carrying a load of F-51 "Mustang" fighters which will be used for tactical air support. The aircraft were "in mothballs" in the United States and had to be overhauled.

[4] On July 4th, 1950, a total of 34 sorties was flown in Korea. In comparison, the greatly weakened German Luftwaffe flew 50 sorties over the Normandy landing beaches on June 6th, 1944. Since the Korean Peninsula has a width of between 120 and 150 miles, south of the 30th Parallel, one may claim that practically no American air cover was available over the actual combat area.

across the Channel in the night of June 5th, 1944, but six months of war in Korea would obviously cost even more.

We have never been able to adopt the point of view that the air arm alone is sufficient to satisfy all strategic requirements, and there is no doubt that the ground forces must be trained to fight without air support, be it only to keep things going on days on which fog, a low cloud ceiling or a storm nails the air force to its bases. But in 1950, an army without a powerful airborne component is just as inconceivable as a navy without a naval air arm. And in this respect one might be entitled to criticize the occupants of the Pentagon, for their concentration on the concept of strategic air bombardment seems to have made them overlook the value of the less spectacular operations of the tactical air support units. But it is absurd to claim that the air arm has proved its impotence in Korea.

*

Now to discuss the rôle of armour. We readily admit that we sprouted goose pimples upon reading, below the by-line of this or that war correspondent in Korea, that the Soviet-built tanks were regularly outclassing the tanks operated by the Americans. In our naïve candour we imagined whole companies of 1944 "Pershing" tanks or 1949 "Patton" tanks being shot up and forced back by the impact of the T 34's which made their first and brilliant appearance on the Russian front in 1941-1942, and we wondered if the rigid laws of mechanics had finally submitted themselves to the imperatives of Marxist dialectics, following the example of botany under the ideological management of Professor Lysenko.

We have been reassured on that point, however, for today we know that the armoured forces of the Twenty-Fourth Infantry Division are equipped with nothing more serious than "Sherman" tanks which first went into action on the battle fields of El Alamein at the end of October, 1942. Between the American and the Soviet tanks one can draw the following comparisons : their weight, armour, speed and range are roughly equal. The T 34 is of lower silhouette and has better contours than its rival. Thus it is less vulnerable in the field.

The main armament of the *General Sherman* tank is a 75 mm gun in the turret, firing a shell weighing about 13 lbs. (6 kg.) at a muzzle velocity of 2,000 ft./second. The 3-inch (76.2 mm) gun of the Soviet tank is an adapted anti-aircraft gun, the recoil of which is damped by a muzzle brake, an improvement on the American gun. Furthermore, its shell, of roughly the same weight as the American projectile, has a muzzle velocity of about 3,000 ft./second. Several differences result : the trajectory of the Soviet gun is flatter, its fire is more accurate and the shell is capable of piercing the front armour of the Sherman. The latter is deprived of these qualities. While in the Taejon or Yongdok sectors a number of improved "Sherman" tanks are available, armed with British 3-inch guns, also known as seventeen-pounders because of the weight of their projectile, some of the T 34's engaged in the Battle of Korea carry 85 mm anti-aircraft guns of similar size and efficacity to the famous 88 mm guns of the *Luftwaffe* and the German Army. Hence it seems that for the time being the tactical advantage lies with the aggressor, who can engage the defence without coming within the range of the latter's guns.

According to American war correspondents, Korea is nothing but a vast sea of mud during the monsoon period, and the tanks reportedly bog down completely in the countless rice paddies. In these particular circumstances, the Russian tanks have another important advantage. The wide track of the T 34 permits it to manœuvre with relative facility in country which is entirely inaccessible to the "Sherman" tanks, the tracks of which are much narrower. This lack of manoeuvrability, which was discovered in the course of the fighting in Normandy, was corrected in the design of the "General Pershing" tank, which went into action in the Aix-la-Chapelle sector in the winter of 1944-1945.

South Korean soldiers inspecting a Yak 9 of the North Korean Air Force, shot down by an American fighter.

Armed with a 90 mm gun, equipped with a muzzle brake, this type of tank would probably have been eminently suited for Korea, probably much better than its successor, the *"General Patton"* tank. But what should one think of military leaders who discard their kings and aces in order to be able to throw threes and fours on to the table ? So far as the much-vaunted T 34's are concerned, it is piquant to recall that this type of tank is nothing but an adaptation of the American *Christie* tank which, about 1935, was entirely incapable of impressing the War Department in Washington.

Nobody should be surprised that the recoilless 57 mm guns of the US Eighth Army, more often than not, have failed to have any effect whatever on the armoured columns of Pyong Yang. At the time of Stalingrad, the German 50 mm *Pak* anti-tank gun, which fired an 11-lb. armour-piercing shell, was equally impotent in the face of the same adversary. The shaped charge of the rocket-propelled 80-mm projectile of the *Superbazooka* is reported to have knocked out fifteen T 34 tanks within a period of 48 hours. This, therefore, seems to be an excellent defensive weapon, but it should be pointed out that the American forces in Korea were not initially equipped with it. The few that are in action in Korea had to be tranported by air from one coast of the Pacific to the other. In this connection, the intimate collaboration of the different branches of the Communist Army are of great interest : the artillery follows the armoured columns very closely, partly in order to knock out the enemy's anti-tank defences and partly to neutralize any armoured conter-attacks the enemy may launch. In a modernized version, adapted to new circumstances, these are the same tactics as those employed by the Soviet Army between June 22nd, 1941, and May 8th, 1945.

Conclusions

If we have succeeded in making ourselves clear, the conclusions are self-evident. If we have been unclear, conclusions are impossible to arrive at. What we have been trying to explain is that, in the field of battle mysteries and miracles have no place and that the eternal law of cause and effect is most brutally applied in war. The speed of modern warfare does not forgive lack of preparation on the part of great nations such as the United States. Initial handicaps can be overcome only at the cost of bloody humiliations and expensive improvisations.—So far as small and medium-sized nations are concerned, they will not be able to escape facing two alternatives : either to be prepared, or to be annihilated.

P.S.—Readers should keep in mind that the above article was written between July 18th and 21st, 1950, on the basis of official war communiqués and press comments.

David and Goliath : the Mooney M-18 L "Mite" shows off in front of a Boeing "Stratocruiser" of British Overseas Airways Corporation.

American Racing and Sports Single-Seaters

Standardized Midget Racers

For more than two decades the design of higly-bred single-seater racing aircraft has been an American tradition. The *National Air Races* in Cleveland and the *All-American Air Manoeuvres* in Miami, which have attracted tens of thousands of spectators year after year, offered ample opportunity to designers to demonstrate their latest creations. Pilots had a chance to show that these contraptions could actually fly—but only just. Flying the things was not always very easy, but the hottest pilots collected fat purses.

Many of the aircraft were piloted by their designers. To this category belongs the pastmaster of the sport, *Arthur C. Chester*, who killed himself in a race in 1948, and his equally-famous colleague, *Steve Wittman*. Another was *Tony LeVier*, Lockheed's Chief Test Pilot, who personally demonstrated his aircraft for many years until his employers pointed out to him on which side his bread was buttered and asked him to spend his off-hours in more leisurely pursuits. Now, though he still is the President of the *Professional Race Pilots Association*, he no longer flies in races himself. But the aircraft he designed, in collaboration with Glenn Fulkerson, a Lockheed aerodynamics engineer, are still regular entrants. One of them is the famous "Cosmic Wind."

Before the war aircraft builders were absolutely free to elaborate their own designs. The list of thirty entrants for the 1938 Cleveland races, for example, included such diverse types as the "San Diego Flagship" which had a span of *thirteen feet* and a 90 h.p. engine, and two "civilized" 1,200-h.p. single-seater fighters. While most of pre-war racers were somewhere in between these extremes, with engines developing from 290 h.p. to 700 h.p., the aspect of some of them

A pre-war racer of Art Chester with a 290-h.p. Menasco C68-4 engine in front of a long fuel tank.

One of Art Chester's recent designs is this midget racer with an 85-h.p. Continental engine and butterfly tail.

was extraordinary. In addition to the closed-circuit races, which always took place just above the heads of the spectators, a Bendix Trophy long-distance race from Southern California to Cleveland, Ohio, was a regular event. In the aircraft used for the latter race the pilot used to sit just ahead of the rudder to make room for the large gasoline tanks.

Generally speaking, it was the most powerful engine that won the race. After 1945 war surplus fighters like the Goodyear "Corsair," the North American "Mustang" and the Bell "Kingcobra" were in great demand with the racing pilots and promptly got all the purses. And in 1949 even military pilots on active service entered into the fray, banked their North American "Sabre" jet fighters around the pylons 105 times, blew out most of their skin rivets, used up more than 400 gallons of fuel apiece and reached average speeds of 580 to 586 miles per hour. The powers that be finally decided that this was too much of a good thing, especially after a number of fatal accidents had occurred, notably the one killing Bill Odom, famous and popular round-the-world record flyer.

Thus it came about that Defence Secretary Louis A. Johnson banned American military aircraft from taking part in the National Air Races, and the race management has decided no longer to permit the entry of converted military aircraft. Furthermore, it resolved not to hold the National Air Races this year. — Meanwhile, the racing pilots planned a number of smaller events in various States, limited strictly to midget racers. One of these races, at which some of our pictures were taken, was held a few weeks ago at Westchester, New York.

As a result, considerable prominence has been achieved by a development initiated by the cleverly-drafted conditions for the *Goodyear Trophy Race* sponsored by the Goodyear Tire and Rubber Co. as part of the 1947, 1948 and 1949 National Air Races : the engines of the racers were limited to a maximum of 190 cu.in., total piston displacement, i.e., power of about 85 h.p. Even though this limit may be raised in the near future, and a few indications to this effect are available, the sporting character of the event, reestablished after a long lapse of time, will not be prejudiced. At the beginning of 1949 the *National Aeronautic Association,* which represents the US flying clubs in the Fédération Aéronautique Internationale, gave its official blessing to the Goodyear Trophy conditions and issued official specifications for the future design of the midget racers.

Required are engines with an Approved Type Certificate and a total piston displacement not exceeding 190 cu.in. Direct fuel injection will be admissible, but not water injection. Propellers must be of fixed pitch in flight but may be adjustable on the ground ; wings must have a minimum area of 66 sq.ft. ; landing-gear must be fixed, either tricycle or tail-wheel type, equipped with brakes ; minimum fuel capacity required is 15 US gals. and dry empty weight must be at least 500 lbs. Other regulations make sure that only robust and thoroughly tested types, flown by experienced pilots, will take part in the contests. Parachutes, shoulder harness, crash helmet and nose-over trusses are compulsory.

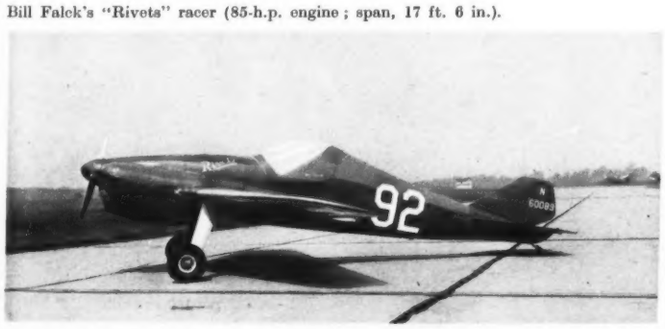
All recent midget racers are equipped with Continental flat-four engines, mostly Type 685-8FJ with direct fuel injection. Their span ranges from 17½ ft. ("Rivets") to 19½ ft. ("Cosmic Wind"), wing area and empty weight are just above the prescribed minimum, and

Tony LeVier, Lockheed Chief Test Pilot, naturally knows his business. But midget racers of the type of his "Cosmic Wind" (85-h.p. Continental engine) are not very easy to fly.

Bill Brennand, 108-lb. "jockey pilot," won the last Goodyear Trophy Race at Cleveland and the Westchester race on a Steve Wittman midget racer powered with an 85-h.p. Continental engine.

"Belle of Bethany," a new midget racer of Lazor-Rautenstrauch (85-h.p. engines ; span 18 ft. 6 in.).

Bill Falck's "Rivets" racer (85-h.p. engine ; span, 17 ft. 6 in.).



W. B. Denight's "Special" (85-h.p. engine ; span, 18 ft. 9 in.).

One of the first Long LA-1 "Midget Mustang" all-metal midget racers belongs to Luther Johnson, of Greenwood, South Carolina (85-h.p. engine).

The prototype of the "Par Special" pusher midget racer was designed and built by four engineers, G. Owl, E. Painter, B. Short and A. Beckington. It recently took part in an air race in Tennessee.

George Bogardus, aircraft engineer from Troutdale, Oregon, flew his "Little Gee-Bee" across the American Continent in three days (65-h.p. engine).

the maximum speed usually is something like 200 m.p.h. The average speed reached in the actual race therefore depends largely upon the pilot's dexterity. In addition, the slightest differences in surface finish, wheel fairings, cylinder fairing ducts, engine grooming and fuel formulae can be decisive factors for success or failure. *Bill Brennand,* a very youthful and daring pilot, won the first prize of $7,320 in the last Goodyear Trophy Race in his flaming red Steve Wittman racer. He averaged 177.3 m.p.h. over the 12-laps of the 1 3/4-mile circular course. In the same aircraft he later won the Westchester Race. Incidentally Brennand, who weighs 105 to 108 lbs., depending upon the copiousness of his midday meal, is the lightest of all the racing pilots, which no doubt is a factor contributing to his victories.

From a design point of view the all-metal "Midget Mustang" (85-h.p. Continental engine) developed by *Dave E. Long,* Chief Designer for Piper Aircraft Corp., no doubt is the most interesting type besides the "Cosmic Wind" all-metal racer (three of which are flying) and the "Par Special" pusher prototype. Two "Midget Mustangs" differing only in detail were recently completed at Lock Haven, Pa., and another few will be built this year. Price will be $4,995 f.a.f. The manufacturers hope to start production on a larger series in the near future and to market the type as a standard midget racer or as a high-performance single-seater touring aircraft. Dave Long employed a laminar-flow airfoil with its maximum thickness at 40 percent of chord; aspect ratio is 1 : 4.96. Landing flaps and control surfaces have metal skin.

Dimensions and Weights: Span, 18 ft. 6 in.; length, 16 ft.; height, 4 ft. 6 in.; tread, 6 ft.; wing area 69 sq.ft.; empty weight, 525 lbs.; gross weight, 850 lbs.

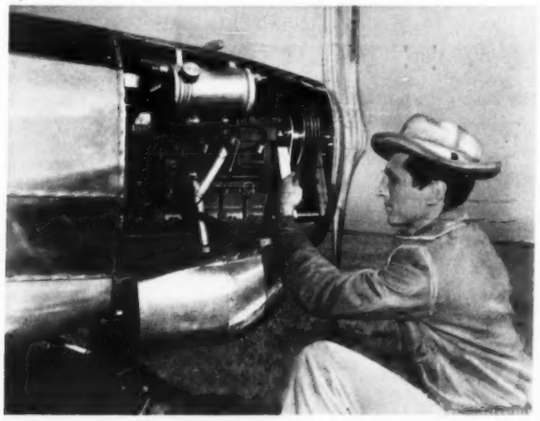
Performance: Maximum speed, 200 m.p.h.; landing speed with flaps down, 53 m.p.h.; take-off distance over 50 ft. obstacle, 610 ft.; rate of climb, 1,580 ft./min.; service ceiling, 22 500 ft.; range, 410 miles.

"People's Aircraft" and Single-Seater Tourers

As everywhere else in the world, America has a number of designers trying to make the dream of many a young man come true, namely, a cheap, fast single-seater sports aircraft. One of these engineers is *A. W. Mooney,* ex-Chief Designer of the defunct Culver Aircraft Corp. A few years ago he founded Mooney Aircraft Inc. at Wichita, Kansas, and produced the *M-18,* a single-seater of wood-and-metal construction powered with a 27-h.p. Crosley automobile engine. The high engine speed (4,500 r.p.m.) was reduced through four Goodyear belts, reinforced with steel cables, to about 1,950 airscrew r.p.m. A light-weight radiator was fitted under the engine cowling, and the aircraft had a retractable nose-wheel landing-gear. Gross weight was about 700 lbs., cruising speed about 87 m.p.h. Eight US gals. of automobile gasoline was needed for the trip of 400 miles. The CAA awarded the aircraft an Approved Type Certificate, five aircraft underwent operational tests, and the price was initially pegged at $1,500. But the model suffered the usual fate of such designs : it

Simplified fuelling : the tank of the M-18 took 8 US gallons, sufficient for a 400-mile flight.

Five Mooney M-18 sports single-seaters were equipped with 27-h.p. Crosley water-cooled automobile engines; the airscrew was driven by four belts.



Straight leading edges on the wing and elevator unit characterize the Mooney M-18 L "Mite" sports single-seater (65-h.p. Lycoming engine). The tricycle landing-gear is mechanically retractable.

A view of the instrument panel, controls and the landing-gear actuating lever. A mechanical warning flag (top left) indicates the landing-gear position. Flap operation and tailplane trim setting are mechanically interconnected.

The de luxe version of the Mooney M-18 L "Mite" is equipped with VHF radio telephone, blind flying instruments, navigation lights and landing light.

was underpowered after all, take-off and climb performance (400 ft./min. at sea level) was not sufficient. A more powerful version, the M-18 L "Mite," succeeded the M-18.

George Bogardus, of Troutdale, Oregon, showed a little more foresight when he fitted a 65-h.p. continental engine to the "*Little Gee-Bee*" he built with his own hands in one year's labour of love at a cost of $500 for building materials. With a span of 29 ft. 8 in. and an empty weight of 485 lbs. (gross weight, 800 lbs.), he reached a top speed of 120 m.p.h. In 1947 he flew his "Gee-Bee" across the Continent in three days. He spent $28 for 111 gallons of gasoline and some oil.

The latest creation in the field of single-seater sports aircraft is the *Mooney M-18 L "Mite"* mentioned above. It is powered with a 65-h.p. Lycoming 0-145 horizontally-opposed engine. According to latest reports it is in production at Wichita and costs $1,995 fly-away factory. Two aircraft are turned out a week, and an increase in this rate is projected. Quite recently Al Mooney, flying one of his "Mites," established a light-plane record by travelling, 1,440 miles from Brownsville, Texas, to Watertown, South Dakota, in 10 hours 45 minutes.

The "Mite" is an attractive low-wing monoplane of composite construction and should provoke many a flutter in the hearts of sporting pilots. Its performance of 136 m.p.h. top and 20,000 ft. ceiling is good. The landing speed of 40 m.p.h. with flaps inspires confidence. Its "Simplifly" control system (Mooney patent) interconnects flaps and tailplane (hinged to the fuselage at leading edge) and provides automatic trim settings for every condition of flight : take-off, climb, approach and landing. The nose-wheel is steerable and, like the main wheels (which are fitted with brakes), retracts manually. A special de luxe version, equipped with VHF radio telephone, blind flying instruments, navigation lights and landing light (in the fuselage nose), has been completed.

Dimensions and Weights : Span, 26 ft. 10 in. ; length, 17 ft. 7 in. ; height, 6 ft. 2 in. ; wing area, 95 sq.ft. ; empty weight (normal version), 500 lbs. ; gross weight, 780 lbs.

Performance : Top speed, 136 m.p.h. ; recommended cruising speed, 115 m.p.h. ; landing speed, with flaps, 40 m.p.h. ; take-off distance over 50-ft. obstacle, 750 ft. ; rate of climb at sea level, 1,100 ft./min. ; service ceiling, 19,400 ft. ; range, 440 miles with 11 US gals. of fuel.

Thus it is evident that useful, lively sports aircraft have resulted from two development trends, namely, from a reduction in the size of racing aircraft and from an increase in the power of sporting types. Typical of the two trends are the 85-h.p. "Midget Mustang" racer with a span of 18½ ft. and the 65-h.p. "Mite" sports single-seater of 27-ft. span. Many of our readers will regret that they are separated from these creations by an ocean and a forest of unpleasant customs and currency red tape.

Three's a Crowd... but Two isn't Company...

PAA-AOA Merger

BY CHRIS ROBERTS, WASHINGTON

The size, variety and vehemence of the opposition is the surest measure of the advantages accrueing to Pan American World Airways by its purchase of American Overseas Airlines. The major argument put forth by rival groups has always been cries of "monopoly," which stem somewhat forlornly back to the famed "chosen instrument" fight which raged in the US in 1945, but no really substantial data have appeared supporting such a claim.

Fundamentally, the issue has been simply an "anti-Juan Trippe" battle, and such fear on the part of the opposition is the best possible tribute to the stature of the man. Rightly or wrongly, by fair means or foul, he has moulded a behemoth in the international airline field which is further strengthened by acquisition of AOA. But his intimate friends reveal that Trippe would gladly trade all of his far-flung airline empire for a single transcontinental domestic route in the United States.*

It is against this background that the significance of the AOA purchase must be assessed : it indicates that the deal is only of secondary importance in Trippe's long-range business plans. By obtaining AOA, Trippe has strengthened his trans-Atlantic operation, but it has pushed even farther into the future the utterly remote possibility of his obtaining a domestic route in the US Yet, he needs it for two reasons : (1) its profits, and (2) its welding the final link in a true round-the-world commercial airline. Failing this, however, he is determined to build his existing overseas routes to a position of dominance in the field and keep it there.

The merger gives PAA greatly increased schedules over the heavily-travelled New York—London route (over which PAA and AOA routes are parallel) and takes PAA into Berlin. These are the two principal changes resulting from the consolidation. PAA gains certain other routes, such as through Glasgow, Scotland, and into the Scandinavian region (Oslo, Copenhagen and Stockholm) and brings Amsterdam and Frankfurt into its route pattern ; however, these are competitive routes with gradually-diminishing traffic over the past year. AOA is also certificated to serve Finland, Estonia, Latvia, Lithuania, Poland, Leningrad and Moscow—routes of only academic interest since their authorization. Thus, AOA routes in Europe lie north of the 50th parallel. Combining these northern routes with PAA's existing "central" routes, gives PAA all of the traffic lying north of the Mediterranean contries (France, Italy, Greece, Egypt, Palestine, etc.).

The authorization brings to a close a five-year battle between the major carriers and the US Government. It all began back in the Spring of 1945 while World War II was at its height. Senator Pat McCarran (Dem., Nevada) introduced his famed S. 326 Bill in the Senate which embodied an "All-American Flag Line" plan in which all domestic air carriers would become shareholders, while equipment and personnel would be delegated to the line on a pro-rata basis. From the beginning there was a certain degree of sense to this proposal because at its root lay a means by which the assets of the nation could be thrown into the battle against nationalized foreign competition. The only thing wrong with the idea was that PAA was to have 25 percent of the voting stock in the line, the other interests ranging from 12½ percent for United Air Lines down to 2½ percent for about 15 small domestic airlines. It was this majority of interest on the part of PAA that immediately made Trippe the target for charges of "chosen instrument," "monopoly," etc.

Meanwhile, American Airlines completed arrangements for the purchase of 51.4 percent of the stock of American Export Airlines, the sale of which had been ordered by the Civil Aeronautics Board. American Export was formed in 1937 by American Export Lines, the shipping company, and the CAB ruled in 1945 that no airline could be operated as an adjunct of a surface transportation company. American Airlines offered to buy 120,000 shares of the treasury stock of American Export for $25 a share, or $3 million. Action on this sale was delayed by the CAB until it awarded the three certificates for the North Atlantic, and the decision announcing these routes July 5th, 1945, also contained approval of the AA-AEA merger. Juan Trippe and William A. Patterson, United Air Lines, had strenuously opposed this merger. Patterson, for reasons obvious from the breakdown of interests in the proposed All-American Flag Line plan, had joined Trippe in his battle for the McCarran Bill. Patterson fought the merger because of the tie-in between the North Atlantic route and American's domestic route ; AA could offer one-line service from California to Europe, whereas UAL could take the passenger only to New York, where he had to transfer to (preferably) Pan American Airways. Trippe fought the merger for equally obvious reasons, being convinced that American Export would offer him little competition.

The current battle began in December, 1948, when Trippe and C.R. Smith, AA and AOA president, completed arrangements for the transfer of AOA. The original arrangement involved no cash. AA was to receive PAA stock equivalent to the value of AOA's 1,749,825 shares outstanding at a cost of $10.77 a share or its book value as of December 31st, 1948, whichever was higher. PAA's stock was also to be valued as of December 31st, 1948. (Involved in the deal was the transfer of the 10 million shares of $2.50 per share value of Pan American Airways Corp.—the holding company—to Pan American Airways, Inc.—the operating company.)

Two financial problems would be created by this arrangement. American Export Lines held 20 percent of the AOA stock and they would therefore become substantial PAA stockholders. Because American Airlines would wind up with a very substantial interest in PAA in the deal, arrangements included the creation of a voting trust for this stock, with one PAA, one AA and a third trustee controlling its voting. However, AA intended to dispose of its PAA stock on the market.

Because it involved no cash, the arrangement was immediately suspect as it entered the Civil Aeronautics Board's complicated approval machinery (it took 1½ years to process the request for approval !). Partly to overcome this objection, and partly to

* See "INTERAVIA" No. 9, 1949.

Juan Terry Trippe, President of PAA.

C. R. Smith, President of AA and AOA.

accommodate changes in the market in the ensuing 10 months, a new arrangement involving all cash was submitted in October, 1949. This was an offer by PAA simply to buy AOA for $17,450,000 cash. In the special audit completed as of December 31st, 1948, it was ascertained that AOA's book value was $18,845,651. Since PAA's stock was found to be worth $15.79 a share, it would have required 1,193,844 shares to match the value of AOA's assets, had the deal been approved as of that date. However, by October, 1949, PAA's stock had dropped to about $9 a share, so that the stock involved in the December 31st, 1948, arrangement was worth only $10.7 million in October, 1949. The cash offer of $17,450,000 thus meant about $6.8 million more to AOA shareholders than the original deal.

Through stock purchases, AA had acquired 61.9 percent of AOA's stock since its original purchase, so that the new arrangement meant about $10.8 million to AA out of the sale. American Export also stood to gain about 50 percent appreciation out of its original holding. American had advanced $1.5 million to AOA in the form of a note and had agreed to an additional $1.5 million. Meanwhile, AOA had obtained a $10 million credit, which removed the necessity for AA's loan of $1.5 million and greatly increased the prospects of its receiving its original $1.5 million back from AOA.

To finance the deal, Trippe went through one of the very rare instances of his borrowing money, and established a line of credit of $59 million. Not only does this money handle the AOA deal but it also accommodates PAA heavy equipment purchases (Stratocruisers, Convair-Liners, etc.). The new cash agreement was extended until March 13th, 1950, and then to June 13th, 1950, and then for an additional three-month period.

Piecing together the pieces, this is what apparently happened in the Board : the merger was opposed from the start by a majority of the CAB, particularly by Chairman Joseph O'Connell, who is strongly in favour of competition under heavy regulation. The final decision was 3-2 against approval. Since all overseas route decisions of the Board must be approved by the President, this decision was sent to him for action. His personal aide, Clark Clifford, had resigned some time before and joined the law firm representing the interests of Trans World Airline, one of the most vigorous opponents of the deal, and Clifford went to see the President for a chat. After he left, the President agreed with the CAB's negative decision, and the merger was off. Meanwhile, however, the parties interested in seeing the transaction go through had not remained idle. Pan American Airways has access to many doors, its Board of Directors includes such people as ex-Secretary of State George Catlett Marshall, representatives of powerful banks and economic interests. The case was submitted to President Truman once again, and only a few days after the rejection of the merger the President reversed his decision and ordered the merger approved. When this came to the Board, Chairman O'Connell saw no alternative but to resign from his post.

News of the decision leaked out in Washington when it was submitted to District Court in the District of Columbia by the Department of Justice. James M. Landis, former CAB chairman and now representing a group of AOA employees who want to buy the airline themselves, sought and obtained an injunction before Judge Henry A. Schweinhaut in District Court against the formal issuance of the order approving the merger. Into this situation stepped Trans World Airlines, bitter foe of the merger, with a request to the Board that it reconsider its proposed order and reopen the case. A further complication of the situation was the almost-simultaneous release of a CAB Examiner's report recommendig approval of the existing ownership of 73 percent of TWA's stock by the Hughes Tool Co., which is solely owned by Howard Hughes. This brings back into the situation the famed conversation that took place between Hughes and Trippe two years ago looking towards a merger of PAA and TWA.

It is difficult to imagine a more complex financial and political situation than now exists, which always occurs when the stakes are high. Acquisition of AOA by PAA will have no really drastic consequences in the North Atlantic air traffic picture. But this leaves PAA and TWA as the only US competitors over the route and Hughes and Trippe are well-known to have discussed merger two years ago. Able Ralph S. Damon quit the presidency of American Airlines when Board Chairman C.R. Smith completed the negotiations with Trippe without Damon's knowledge. Damon opposed the sale of AOA all along. Damon is now president of TWA and has been the severest and most caustic critic of the PAA-AOA merger. Negotiations between Trippe and Hughes at some later date would, of course, drive Damon to resignation again.

Joseph J. O'Connell, Jr., has just resigned as Chairman of the CAB.

Howard Hughes, owner of Hughes Tool Co. and some of the largest Hollywood film studios, is TWA's majority stockholder.

No one questions Trippe's ultimate aim to obtain his "chosen instrument" route across the North Atlantic. He failed in his first attempt to obtain it by political means through Congressional action. He is now moving swiftly towards it by financial means. The Civil Aeronautics Board, under Landis and under O'Connell, would never have approved such a plan. But Trippe's *entrée* to the White house makes anything possible. Observers anticipate White House appointment of a new CAB Chairman as a signal for Trippe's future since a pro-White House-Trippe appointee could smooth the way for PAA purchase of TWA's overseas routes.

President Truman, in his approval of the PAA-AOA merger, recommended that PAA be given access to Paris and Rome, the two European cities Trippe has most wanted. But the President also agreed to meet TWA's terms by recommending that TWA be given access to London and Frankfurt, Germany. TWA had earlier stated these two conditions to its withdrawal of its opposition to the merger. However, PAA's service to Paris and Rome will quickly cost TWA far more than it gains by London and Frankfurt authorizations.

It would appear to long-time students of Juan Trippe that he has taken another step in strict accordance with his long-range plan despite the most violent and powerful opposition he has yet met. His final battle will be for control of TWA, which will make him virtual Czar of air transportation of the world, and there are many astute observers who can predict that, although this last battle will make all others look like mere skirmishes, Juan Trippe will win out.

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It is the same Warren Lee Pierson who now again appears on the scene as a result of President Truman's official approval of the merger plan. On July 20th, 1950, the President's verdict was made public. On July 21st Pierson announced that his company had filed a petition for review of the CAB decision with the New York Court of Appeals. On July 26th a motion by TWA for a stay of the CAB order was argued before the Court of Appeals in New Haven, Connecticut. In explaining these measures, Pierson charged that the completion of the merger would be "a long step toward accomplishment of Pan American's ultimate objective, namely, complete monopoly of United States overseas air transportation."

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Warren Lee Pierson, Chairman of the Board of TWA, who has steadfastly opposed the merger.

He has been wrong on this count and, from a strictly unbiased point of view, Juan T. Trippe has been right with his apprehensions. Trippe wanted to create a tightly-knit system of US overseas air carriers in order to meet the growing foreign competition with a powerful American flag airline. And Trippe feared that the European operators, most of which are now run on very efficient lines, would gradually succeed in ousting the USA from the predominant position in international air

transportation it occupied immediately after the war. This speculation has come true in the meantime. While as late as March 28th, 1947, James M. Landis, then Chairman of CAB, still was able to announce at a banquet in Los Angeles that the three US airlines operating on the Atlantic carried 76 percent of the North Atlantic air traffic volume, things are different today. Landis had claimed that the Americans were competing with the foreign carriers on equal terms and succeeded in beating them to a frazzle. The foreigners could not stand up to the Americans. The latter were building better aircraft, the foreigners were buying these aircraft, but the Americans then proceeded to operate them better...

As we have just said, Landis, who today in Juan Trippe's most out-spoken enemy, was wrong. Gradually, year by year, the British and the Continental Europeans have made up for lost time. In the second half year of 1947 the Americans no longer carried 76 percent but only 71.2 percent of the North Atlantic traffic volume. In the first three months of 1950 scheduled airlines carried a total of 50,000 passengers over the North Atlantic, 25 percent more than in the first quarter of 1949. But while the number carried by non-American companies increased by 50 percent, the Americans reported an increase of only 15 percent. The largest gain, 100 percent, was recorded by British Overseas Airways Corporation.

Flashback: Trippe once tried it with kindness. The scene is the cockpit of a PAA aircraft, early in 1950. At the left is Trippe, at the extreme right his present enemy, O'Connell.

We have no idea whether Harry S. Truman will reverse his decision a second time. Nor do we know whether Juan Trippe will emerge as the final victor from this gigantic battle. There is no doubt that he plans to become the Czar of overseas air transportation. Equally, there is no doubt that he possesses the stature to boost air transportation to unprecedented heights. Quite obviously he is a menace for the Europeans. Is he a threat for the American carriers? Only for the weaker ones...

PROFILE OF THE MONTH

Thomas Walter White

When, on the eve of the New Year 1950, Australia's new Prime Minister Robert Gordon Menzies undertook the selection of his Cabinet, his choice for the portfolios of Air and Civil Aviation could not have been more logical. He chose a man with a distinguished record closely linked with the whole history of Australian service and civil flying, who had the added value of considerable parliamentary experience, including previous Cabinet rank.

The new Minister, Thomas Walter White, has a claim to "firsts" in Australian flying history that is probably unique. His story begins with his role as one of four officers, the first graduate pilots from the first course of war flying instruction at the Central Flying School at Point Cook, near Melbourne, in 1914. A nice point of historical sequence is the fact that another of this noted quartet of officers, Richard Williams, now Air Marshal Williams, is the reigning Director-General of Civil Aviation in the Commonwealth.

In that year of graduation, Mr. (soon to become Captain) White was the first Australian pilot to be accepted for overseas war service and he embarked as a member of the now historic First Half Flight of the Australian Flying Corps, a unit which achieved the honour of inaugurating Australia's military air service in war.

While serving on operations in Mesopotamia in 1915, Captain White volunteered with a fellow officer (Captain F. C. C. Yeats-Brown) to fly over the Turkish lines, land, and cut the telegraph link between the Turkish Army's base at Baghdad and its bases extending westward to the Euphrates, Constantinople and Kifri. The sortie was made over extremely difficult country and in the landing, behind Baghdad, a wing of his Maurice-Farman "Shorthorn" biplane was smashed. While White held off attacking Arabs and Turks with his rifle, Yeats-Brown blew up the telegraph line. Their mission accomplished, the two airmen endeavoured to escape by taxi-ing their damaged machine, but failed and were captured. Captain White remained a prisoner of the Turkish Army until August 1918 when, in a railway accident in Constantinople, he escaped. Under disguise he made his way to freedom by way of Odessa and Salonika. His experiences as a prisoner are graphically told in his book "Guests of the Unspeakable," published in 1928. For his war services he was awarded the Distinguished Flying Cross and was twice mentioned in despatches.

Australia's Minister for Air and Civil Aviation, the Hon. T. W. White, *(left)* shows the identity disc issued to him for World War I to Air Marshal Richard Williams, now Australian Director-General of Civil Aviation, with whom he graduated from the first war flying course in the history of Australian Service aviation.

Between World War I and World War II Mr. (by this time Lieut.-Colonel) White commanded the 6th Btn. Royal Melbourne Regiment and at the same time, gave much service in the development of both civil and service aviation. He founded the Australian Aero Club, becoming its first Victorian president and later, chairman of its federal council. He remembers well the early '20s when, with other former AFC pilots, he worked to popularize civil flying and recalls the more adventurous of their patrons queueing up at Essendon (where Melbourne's modern airport is now situated), for passenger flights at five shillings a time.

In those years Mr. White was associated with the Rev. John Flynn, now revered as "Flynn of the Inland" and at that time superintendent of the Australian Inland Mission of the Presbyterian Church. This association of two "idealists," promoting what many then regarded as an impracticable dream, inaugurated the now historic Australian Flying Doctor Service, of the council of which the Minister is still a member.

Mr. White was elected to the House of Representatives in the Commonwealth Parliament in 1929 and has never been seriously challenged at any subsequent election. From 1933 to 1938 he was Minister for Trade and Customs. When World War II began he joined the RAAF and in April, 1940, he was posted to command No. 1 Initial Training School. In the following year he was posted to England where he commanded RAF Station Brighton until 1943, when he returned to Australia with the rank of Group Captain. The end of the war found him back on the parliamentary benches, an unflagging critic of Government aviation policy, both service and civil—policy which is now his direct responsibility.

Holder of the Volunteer Forces Decoration, associate member of the Institute of Aeronautical Engineers and fellow of the Royal Geographical Society, Mr. White has also turned to verse-writing. Written in the years of the Second World War, this has since been published as a volume entitled "Sky Saga." It suggests that there is a measure of poetic justice in the turn of the political wheel which has brought him, with his intimate experience of flying in both war and peace, into line as Australia's Minister for Air and Civil Aviation.

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These latest developments might be regarded as contradictory to certain speculations of our Washington contributor (see above). If Howard Hughes, controlling shareholder of TWA, tentatively did negotiate with Juan Trippe some time ago and if he is not absolutely opposed to yet another merger, then the attitude of Warren Pierson would run counter to the views of his company's majority shareholder and actual boss. Howard Hughes, who after all is an important man in American air transportation, made a somewhat mystifying comment on the merger nearly one-and-a-half years ago. He stated that fundamentally he had no objection to the merger, but it would blow up the North Atlantic traffic pattern consisting of three operators, established in 1945, although this pattern was scheduled to remain in force until 1952. Howard Hughes went so far as to calculate that the bigger PAA which would emerge from the projected merger would carry 72 percent of the North Atlantic traffic offering.

Warren Lee Pierson, Chairman of the Board of TWA, who has steadfastly opposed the merger.

He has been wrong on this count and, from a strictly unbiased point of view, Juan T. Trippe has been right with his apprehensions. Trippe wanted to create a tightly-knit system of US overseas air carriers in order to meet the growing foreign competition with a powerful American flag airline. And Trippe feared that the European operators, most of which are now run on very efficient lines, would gradually succeed in ousting the USA from the predominant position in international air

transportation it occupied immediately after the war. This speculation has come true in the meantime. While as late as March 28th, 1947, James M. Landis, then Chairman of CAB, still was able to announce at a banquet in Los Angeles that the three US airlines operating on the Atlantic carried 76 percent of the North Atlantic air traffic volume, things are different today. Landis had claimed that the Americans were competing with the foreign carriers on equal terms and succeeded in beating them to a frazzle. The foreigners could not stand up to the Americans. The latter were building better aircraft, the foreigners were buying these aircraft, but the Americans then proceeded to operate them better...

As we have just said, Landis, who today in Juan Trippe's most out-spoken enemy, was wrong. Gradually, year by year, the

Flashback : Trippe once tried it with kindness. The scene is the cockpit of a PAA aircraft, early in 1950. At the left is Trippe, at the extreme right his present enemy, O'Connell.

British and the Continental Europeans have made up for lost time. In the second half year of 1947 the Americans no longer carried 76 percent but only 71.2 percent of the North Atlantic traffic volume. In the first three months of 1950 scheduled airlines carried a total of 50,000 passengers over the North Atlantic, 25 percent more than in the first quarter of 1949. But while the number carried by non-American companies increased by 50 percent, the Americans reported an increase of only 15 percent. The largest gain, 100 percent, was recorded by British Overseas Airways Corporation.

We have no idea whether Harry S. Truman will reverse his decision a second time. Nor do we know whether Juan Trippe will emerge as the final victor from this gigantic battle. There is no doubt that he plans to become the Czar of overseas air transportation. Equally, there is no doubt that he possesses the stature to boost air transportation to unprecedented heights. Quite obviously he is a menace for the Europeans. Is he a threat for the American carriers ? Only for the weaker ones...

PROFILE OF THE MONTH

Thomas Walter White

When, on the eve of the New Year 1950, Australia's new Prime Minister Robert Gordon Menzies undertook the selection of his Cabinet, his choice for the portfolios of Air and Civil Aviation could not have been more logical. He chose a man with a distinguished record closely linked with the whole history of Australian service and civil flying, who had the added value of considerable parliamentary experience, including previous Cabinet rank.

The new Minister, Thomas Walter White, has a claim to "firsts" in Australian flying history that is probably unique. His story begins with his role as one of four officers, the first graduate pilots from the first course of war flying instruction at the Central Flying School at Point Cook, near Melbourne, in 1914. A nice point of historical sequence is the fact that another of this noted quartet of officers, Richard Williams, now Air Marshal Williams, is the reigning Director-General of Civil Aviation in the Commonwealth.

In that year of graduation, Mr. (soon to become Captain) White was the first Australian pilot to be accepted for overseas war service and he embarked as a member of the now historic First Half Flight of the Australian Flying Corps, a unit which achieved the honour of inaugurating Australia's military air service in war.

While serving on operations in Mesopotamia in 1915, Captain White volunteered with a fellow officer (Captain F. C. C. Yeats-Brown) to fly over the Turkish lines, land, and cut the telegraph link between the Turkish Army's base at Baghdad and its bases extending westward to the Euphrates, Constantinople and Kifri. The sortie was made over extremely difficult country and in the landing, behind Baghdad, a wing of his Maurice-Farman "Shorthorn" biplane was smashed. While White held off attacking Arabs and Turks with his rifle, Yeats-Brown blew up the telegraph line. Their mission accomplished, the two airmen endeavoured to escape by taxi-ing their damaged machine, but failed and were captured. Captain White remained a prisoner of the Turkish Army until August 1918

Australia's Minister for Air and Civil Aviation, the Hon. T. W. White, *(left)* shows the identity disc issued to him for World War I to Air Marshal Richard Williams, now Australian Director-General of Civil Aviation, with whom he graduated from the first war flying course in the history of Australian Service aviation.

when, in a railway accident in Constantinople, he escaped. Under disguise he made his way to freedom by way of Odessa and Salonika. His experiences as a prisoner are graphically told in his book "Guests of the Unspeakable," published in 1928. For his war services he was awarded the Distinguished Flying Cross and was twice mentioned in despatches.

Between World War I and World War II Mr. (by this time Lieut.-Colonel) White commanded the 6th Btn. Royal Melbourne Regiment and at the same time, gave much service in the development of both civil and service aviation. He founded the Australian Aero Club, becoming its first Victorian president and later, chairman of its federal council. He remembers well the early '20s when, with other former AFC pilots, he worked to popularize civil flying and recalls the more adventurous of their patrons queueing up at Essendon (where Melbourne's modern airport is now situated), for passenger flights at five shillings a time.

In those years Mr. White was associated with the Rev. John Flynn, now revered as "Flynn of the Inland" and at that time superintendent of the Australian Inland Mission of the Presbyterian Church. This association of two "idealists," promoting what many then regarded as an impracticable dream, inaugurated the now historic Australian Flying Doctor Service, of the council of which the Minister is still a member.

Mr. White was elected to the House of Representatives in the Commonwealth Parliament in 1929 and has never been seriously challenged at any subsequent election. From 1933 to 1938 he was Minister for Trade and Customs. When World War II began he joined the RAAF and in April, 1940, he was posted to command No. 1 Initial Training School. In the following year he was posted to England where he commanded RAF Station Brighton until 1943, when he returned to Australia with the rank of Group Captain. The end of the war found him back on the parliamentary benches, an unflagging critic of Government aviation policy, both service and civil—policy which is now his direct responsibility.

Holder of the Volunteer Forces Decoration, associate member of the Institute of Aeronautical Engineers and fellow of the Royal Geographical Society, Mr. White has also turned to verse-writing. Written in the years of the Second World War, this has since been published as a volume entitled "Sky Saga." It suggests that there is a measure of poetic justice in the turn of the political wheel which has brought him, with his intimate experience of flying in both war and peace, into line as Australia's Minister for Air and Civil Aviation.

The Weather Service and the First Paris–New York Flight

BY ANDRÉ VIAUT, PARIS

The author, at present Director of France's National Weather Information Service, herewith gives an account of the part played by the Meteorological Service during the preparation for and the actual execution of the first non-stop flight from Paris to New York, the 20th anniversary of which occurs at this time. He does not mention that the success of this meteorological advisory action was due entirely to his own efforts. Throughout the months preceding the flight, he carefully collated weather data for the Atlantic Ocean area. The last 48 hours prior to take-off he spent working out the meteorological charts, explaining them in full detail to the pilots, and determined the most favourable flight course according to the expected meteorological situation. Finally, he selected those ships with whom the aircraft could take up contact en route and arranged for the forwarding of the appropriate directives to them.

THE EDITORS.

At 11 o'clock Greenwich time on August 31st, 1930, the crew of the aeroplane "Point d'Interrogation" ("Question Mark") examined the weather situation over the North Atlantic area and received the latest prognosis concerning its presumable development for the next few days. They decided :

To take off for the Paris—New York non-stop flight in the early morning of September 1st, meteorological conditions in Paris (chiefly visibility) permitting ;

To dispense with auxiliary fuel tanks, which would impede take-off and reduce speed.

On September 1st at 9:55 hrs., the "Point d'Interrogation" took off from Le Bourget Airport, Paris, with New York as its destination. It landed there on September 2nd at 23:12 hours.

Shortly afterwards Costes stated over the American radio network : "We are delighted that our flight, after long and thorough preparation, has been successful. Despite the difficulties confronting us during the crossing, the excellent meteorological information at our disposal facilitated our trip from beginning to end . . ."

These words are nothing but a condensed appreciation of years of ceaseless effort, organization and study.

For the past three years the crew had been continually at work improving the aeroplane which they intended to use for the Paris—New York attempt. In addition, from July 13th on, Costes and Bellonte regularly visited the Weather Office in order to follow meteorological developments over the Atlantic Ocean and US area.

For some years, on the other hand, the expanding meteorological information services operating throughout the seven seas (observations taken from trading ships in the North Atlantic and the use of the training ship S.S. "Jacques Quartier" as a floating weather station) had permitted better knowledge of atmospheric phenomena over the Atlantic. They made it possible to complete charts indicating sea-level atmospheric pressure and thus to determine favourable weather conditions. As regards the Paris—New York flight, the following requirements had to be met :

a) Pressure distribution throughout the greatest part of the route chosen should bring about favourable winds or absolute windlessness throughout the whole flight so as to make possible a non-stop Paris—New York trajectory in a maximum of 40 hours ;

b) The course determined by prevailing weather conditions should lie as near as possible to the main crossings of steamships up to 42 degrees latitude north and 45 degrees longitude west.

c) The weather should be clear throughout the first 1200 kilometers and throughout at least a part of the flight stage to be made at night—this latter because celestial latitude and longitude determinations were indispensable for navigation.

A weather set-up corresponding to such conditions is a rare occurrence. In order to take advantage of it when such a situation does occur, several months must be devoted to continuous and attentive survey of meteorological developments over Western Europe, the Atlantic and the Eastern USA. The last day was given up entirely to an exact study of the most favourable course ; in this connection account had to be taken of the presumable conditions during the trans-Atlantic flight, as well as of conditions over the American Continent and during landing. The last hours prior to taking off were used in investigating weather conditions reigning during take-off and the initial stages of the flight, as well as for the compilation of the weather descriptions to be utilized by the crew in the air.

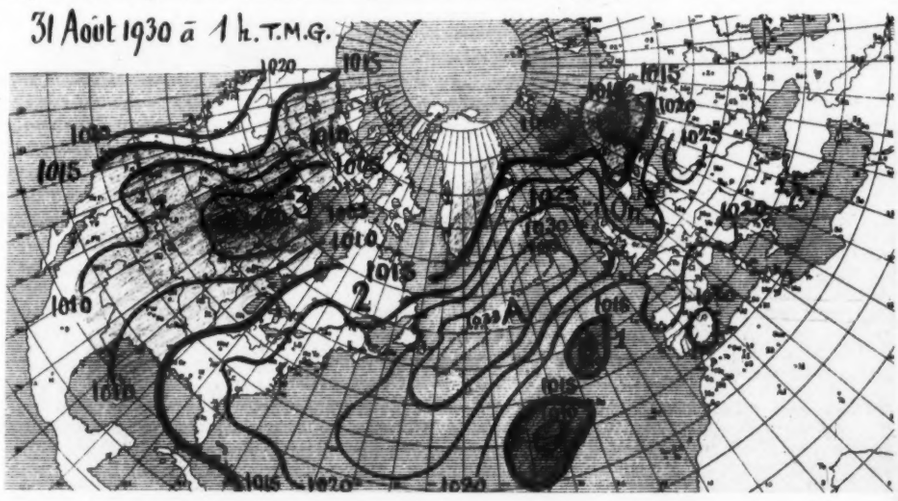
The meteorological situation as determined at the time of the crossing can be described as follows (Fig. 1) :

On August 31st at one o'clock, the rear limit of an extensive high-pressure region (anticyclone) is slowly passing over the Faroe Islands in the direction of Bermuda to migrate slowly towards the East.

One arm of this high-pressure zone is extending eastwards towards the British Isles ; in the West it continues to cover the US East coast.

Three migrating zones of disturbance encircle the high-pressure zone : Zone 1 is located to the West of Portugal and is travelling towards the Northeast ; Zone 2 is situated off Newfoundland and is following the northern edge of the anticyclone ; finally, the third

Fig. 1 : Meteorological chart of August 31st, 1930, morning (01:00 h) **A** Anticyclone **1, 2, 3** Disturbance Centers



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zone is migrating over the North American Great Lakes towards East-North-East (2).

As a result, the task consisted of fortelling as accurately as possible the evolution of the Atlantic high-pressure region and its neighbouring disturbance zones for the period from August 31st until the evening of September 2nd.

From studies made during the morning of August 31st, it could be concluded that the high-pressure region, even though considerably weakened, would remain in existence throughout the Northeast of the Atlantic and over Northwestern Europe, approximately to the North of latitude 55 and to the East of longitude 40 degrees. Hence, especially favourable winds could be expected throughout the region to the South of latitude 55.

On the other side of the high-pressure region, notably between 50 degrees W. and 60 degrees W., it could be expected that a region of more or less constant but fairly high pressure above the ocean would give rise to feeble variable winds prior to disturbance zone 3; this zone was to be flown through somewhere between 62° and 70°. Moreorover, the meteorological situation would make it possible to avoid any noteworthy zones of disturbance between 25° W. and 40° W. and to expect a clear sky for the greater part of the night.

The optimum course was determined on the basis of the following considerations: 1) It was possible without special danger to traverse the northern sector of the zone of disturbance No. 1 by flying below the predominant high and broken clouds; in the case of the precalculated course only a small number of showers between 15° and 27° W. could be expected. 2) It could safely be assumed that the southern portion of zone of disturbance No. 2 would lie between 42° and 48° W. at the time of the flight and would be only slightly active. 3) The southern section of the stronger zone of disturbance No. 3 was to be flown through in daytime between 63° and 73° W. 4) For the last several hundred kilometers, clear weather, at least partially, could be envisaged (Figs. 3 and 5), whereas the landing in New York could presumably take place in the late afternoon of September 2nd under good conditions.

This prognosis caused the Weather Service to recommend the following route: (53° N, 15° W) — (48° N, 30° W) — (42° N, 40° W) Halifax—New York. The suggestion was regarded by the crew as the best of its kind for the next two days and was accepted. Subsequent to September 2nd the course of meteorological events suggested bad weather and adverse winds between Europe and the American Continent for September 3rd.

The aircraft was to fly between the anticyclone and northern sector of disturbance zone 1 and in front of the utmost southern arm of disturbance zone 2; this procedure promised favourable winds for two-thirds of the route and at the same time variable, slight winds for the entire remainder of the over-

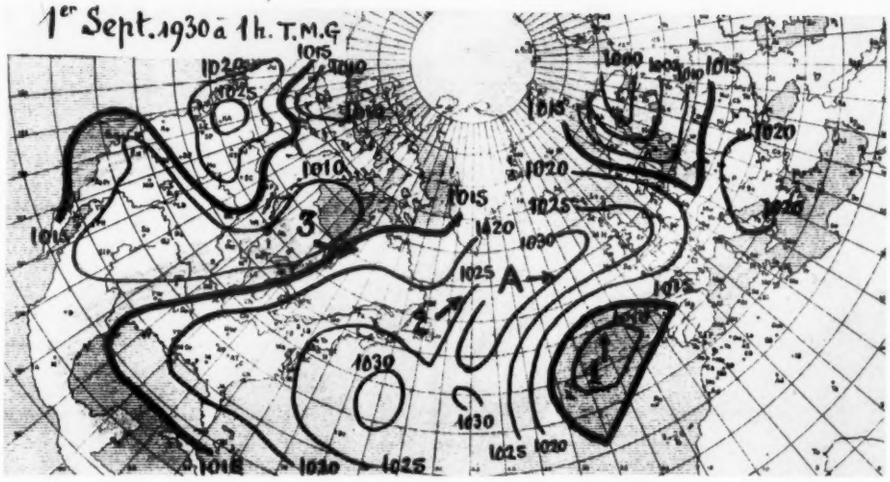


Fig. 2: Meteorological chart of September 1st, 1930, morning (01 : 00 h) A anticyclone 1, 2, 3 Disturbance Centers

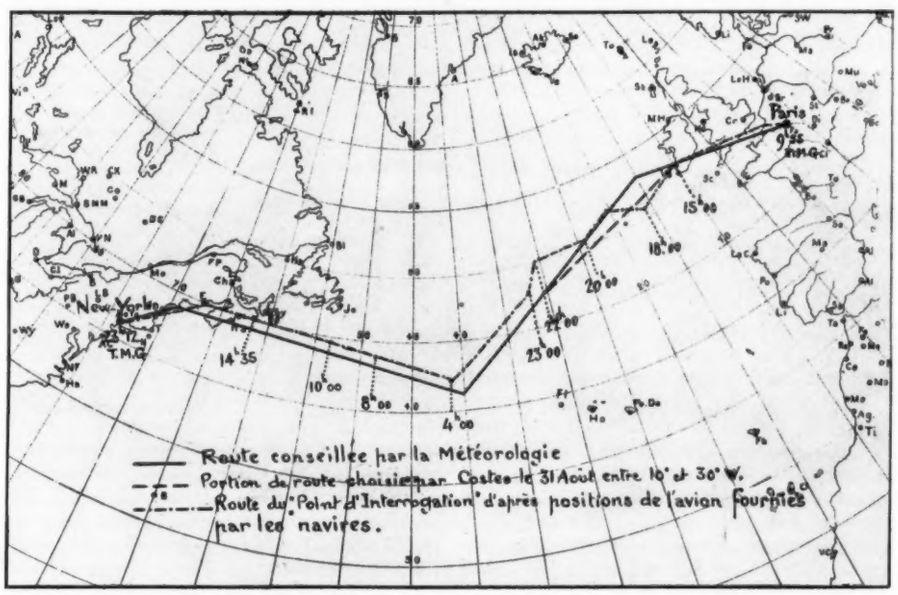


Fig. 3: Flight chart for the Atlantic Trajectory

———— Route recommended by the Weather Service
— — — — Flight route between 10° and 30° W. actually chosen by Costes on August 31st.
—·—·—·— Route taken by the "Point d'Interrogation" as based on the navigational positions supplied by Atlantic ships.

water stage immediately following (Fig. 4).

The data sheets handed out to the air crew on the morning of August 31st consisted not only of meteorological charts with explanations and commentaries but also comprised easily comprehensible graphic descriptions of cloud formation and winds along the planned route for altitudes between 0 and 2000 meters. In addition, an analysis of the flight route was given, which indicated the presumable flight duration for every sector, taking into consideration the expectable wind conditions at the planned flying altitude (an average of 1200 meters).

In point of fact, this analysis was a genuine "flight plan" of the kind prepared today for every longer stage flight in every country of the world.

The estimated overall flight duration calculated with the aid of these plans amounted to 36 hours, the length of the presumable flight trajectory to 6,310 kilometers. The actual flying time reached 37 hours 17 minutes; in this connection it should be noted that the aircraft did not adhere to the pre-established trajectory throughout the entire route, but deviated from it in particular during the part between 10° and 40° longitude W.

The Take-off

The work of the meteorological information service is by no means completed with the decision to take off, finally made at noon on August 31st. On the contrary, observations on the course of the weather are continued and the flight course further improved. While the crew are bringing their aeroplane to Le Bourget airport during the afternoon of August 31st, detailed reports from the USA and the Atlantic are examined; these confirm the development of meteorological conditions as predicted.

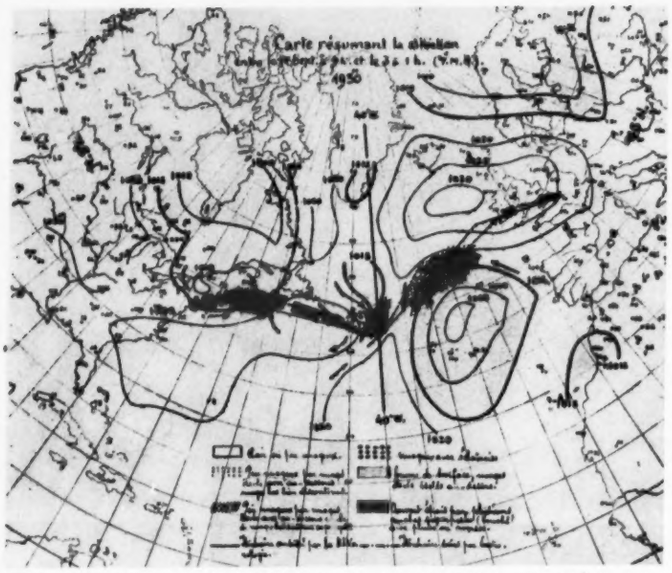


Fig. 4 : Comprehensive weather chart for the situation existing between September 1st, 9 : 00, and September 3rd, 1 : 00 a.m.

Clear or slightly clouded.

Slightly overcast with high-altitude clouds ; at lower levels broken cloud formations.

Slightly overcast with high-altitude clouds ; at lower levels more or less continuous cloud ceiling.

Flight route recommended by Weather Service.

Overcast with occasional clear sky.

Sea-level fog, above which occasional high-altitude clouds.

Strongly overcast with several cloud ceilings one above the other ; rain or showers.

Flight route taken by Costes.

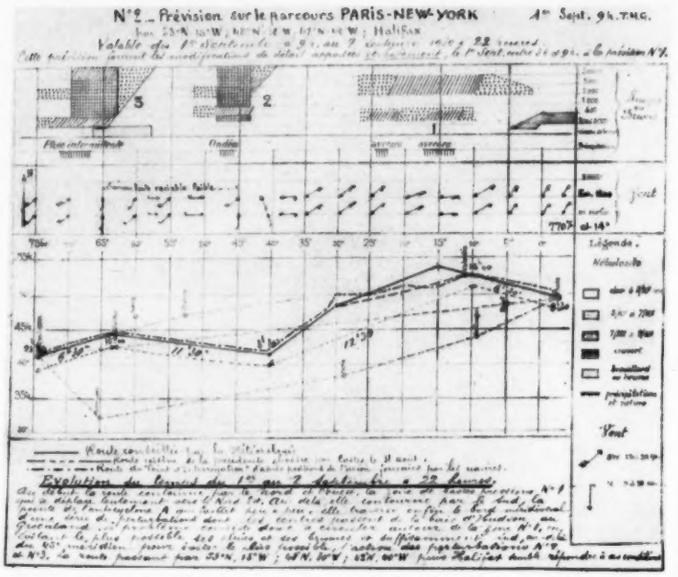

N°2 — Prévision sur le parcours PARIS-NEW-YORK
Valable du 1er Sept. 9h. T.M.G.
Halifax
Evolution du temps du 1er au 2 Septembre à 22 heures.
Vent

Fig. 5 : "Weather Prediction No. 2 for the route Paris—New York over 53°N., 15°W. ; 48°N., 30°W. ; 42°N., 40°W. ; Halifax.
Valid from September 1st, 9 : 00 to September 2nd, 22 : 00, 1930. This prediction takes into account the *orally* reported individual corrections to prediction No. 1, supplied on September 1st between 3 : 00 and 9 : 00."

———— Flight route recommended by Weather Service.
— — — — The actual route chosen by Costes on August 31st next to the above.
— · — · — · Route flown by the "Point d'Interrogation" in accordance with the navigational positions reported by ships.

Further Developments from September 1st to September 2nd, 22 : 00.

Initially, the flight route led in a northerly and westerly direction circumventing Low Pressure Area N° 1, slowly migrating to the northeast ; later the advance point of Anticyclone A, gradually, breaking up, is circumvented to the south. Finally, the course leads through the southern boundary of a number of disturbance areas, whose centers are migrating from Hudson Bay towards Greenland. As a result, the problem consists of circumventing Zone N° 1, avoiding as far as possible its rain and fog sections, but at the same time, after reaching Longitude 45°, of remaining south sufficiently to avoid the effects of Disturbance Areas N°s 2 and 3. The route indicated seems to comply with these requirements.

At the same time, the positions of the Atlantic ships to be utilized for the transmission of information are determined. It is chiefly the S.S. "Ile de France" and S.S. "Rochambeau" who are to forward wireless messages to the aircraft during the first ten hours of flight.

In the night from August 31st to September 1st, a new isobar chart is compiled for use in flight, on the basis of observations taken at 13 hours. This indicates centers of disturbance and their direction of migration.

Observations taken at one o'clock permit a new chart to be drafted at 3 a.m. ; this is accompanied by an overall report for the flight trajectory supplementing that delivered at 11 o'clock on the preceding day. With these data the crew will be in a better position to follow up the last moment changes communicated en route.

In addition, while take-off is postponed owing to early-morning fog over Le Bourget, Atlantic weather conditions continue to be reported at the aerodrome itself hourly on the basis of communications still sent in.

Finally, after an observation flight by Codos reports sufficient visibility and ceiling for safe take-off, the "Point d'Interrogation" gets under way. It is 9 : 55 hrs.

En Route

On four different occasions the weather forecasting service in Paris supplied the aircraft with meteorological reports relayed by S.S. "Jacques Quartier" and "Rochambeau." These reports indicated the momentary position of the anticyclonic and disturbance centers. Completed by the latest observational data taken from the vessels themselves, collated on board the "Jacques Quartier" and relayed from this latter, they made it possible for the crew to test the validity of the prognosis compiled prior to take-off.

Final Remarks

The weather service organized for the Paris—New York flight with the greatest possible precision enabled the pilots to be supplied with the most comprehensive information before taking off and to receive further data and follow the changing situation during actual flight.

Certainly—the participants have stated that their pioneering achievement was made possible by the meteorological flight data they were given. Of greater importance, however, is the fact that the outstanding pioneer flights, and in particular that of Costes and Bellonte, pointed the way to the safety of today's long-distance air schedules, both as regards the choice of meteorologically advantageous navigational routes and the establishment of the necessary ground organization.

In these early pioneering flights, trouble was also taken to clarify weather conditions for the crews and to give them practicable documentation for the projected route. The greater part of the now internationally accepted methods have been developed from the solutions of this task worked out in those early days. That is perhaps one of the most important aspects of this aeronautical weather service. The first atmospheric vertical section with which Arrachart was supplied for his Paris—Irkutsk flight in September, 1926, and the navigational plan (Fig. 5) set up for Costes on his Paris—New York crossing can be looked upon as milestones on the way to the "General Regulations" (for meteorological services to air navigation) as elaborated by the "International Meteorological Organization" in 1939. These directives were completed with regard to certain special questions by the Provisional International Civil Aviation Organization (PICAO) in 1945/46 and later in joint sessions by ICAO and the Meteorological Organization.

Nowadays, for every important or long-distance flight the weather service supplies a compilation of data consisting of an atmospheric vertical section, wind and temperature prognoses for all altitudes between sea level and normal flying altitude, as well as air pressure charts according to ground and upper air observation.

For their part, the crew or a representative of the airline company work out a flight plan based on the first two kinds of documentation just mentioned.

Thus, the historical Paris—New York nonstop flight, like many pioneering performances of those days, not only added to the reputation of France in the field of aviation but paved the way for today's long-distance services.

Air Power Facing the Iron Curtain - II*

Umbrella over the Oilfields

Iran—or Persia, as it is often called again—is one of the most neuralgic spots on this side of the Iron Curtain. The country is potentially wealthy—its 628,000 square miles contain some of the richest oil fields in the world—but militarily it is weak. Most of its 16,000,000 inhabitants are poor. Its industry is practically non-existent, its agriculture is backward. Its strategic situation and mineral wealth make it a critical focal point in the rivalry between the East and the West. The country is situated astride one of Russia's prize ambitions, namely, free access to the Persian Gulf and the Indian Ocean. In the event of war it would be one of the most valuable strategic assets since it possesses enough petroleum to satisfy a large portion of the fuel needs of the Western armed forces and would greatly relieve the US tanker fleet of the burden of carrying fuel across the Atlantic.

In theory the Persians should be able to bask in a sunny feeling of security. The independence and territorial integrity of the country were formally guaranteed under the Anglo-Soviet-Persian Treaty of Alliance of January 29th, 1942 ; this guarantee was confirmed in a special declaration signed at the Teheran Conference in December 1943 by Marshal Stalin, President Roosevelt and Prime Minister Churchill. But since that time the aura of goodwill permeating the anti-Axis camp has given way to the Cold War. It is the former Allies who today are split into two camps, and Persia is one of those smaller countries desperately struggling with the delicate task of keeping on this side of the Iron Curtain without offending the rulers of the Kremlin. How tricky their problem sometimes can become was shown in the middle of July when the Soviet Government complained in Teheran that US so-called oil surveys in the petroleum-rich Soviet-Persian border-regions in reality were camouflaged American espionage activities. The Persian Government rejected the protest but said that, "in order to remove any misunderstanding," air surveys would be forbidden and only Persian engineers would be allowed to carry out ground surveys.

Lieutenant-General M. Yazdan Panah, Minister of War.

Lieutenant-General H. Razmara, Chief of General Staff.

Reza Shah Pahlavi, "The Great."

Mohamad Reza Shah Pahlavi.

It is the task of the Persian armed forces to protect the country against sudden aggression. The Teheran Government is doing all it can to establish an efficient army and air force but is constantly embarrassed by financial difficulties. To some extent the Persians had expected considerable American assistance in their rearmament efforts, similar to that received by the Turks and the Greeks. So far this help has not been forthcoming on any substantial scale and is not likely to be provided in the present circumstances : discussing the US arms aid programme in Washington on June 1st, President Truman stated that Persia would get a slice of the $27,500,000 worth of arms aid to be allocated jointly to Persia, the Philippines and pre-invasion South Korea during the 1950-1951 fiscal year. This is not enough to expand the Persian forces to the required strength and compares with $120,000,000 granted for similar purposes to Greece and Turkey, whose defences already are in better shape than those of Persia.

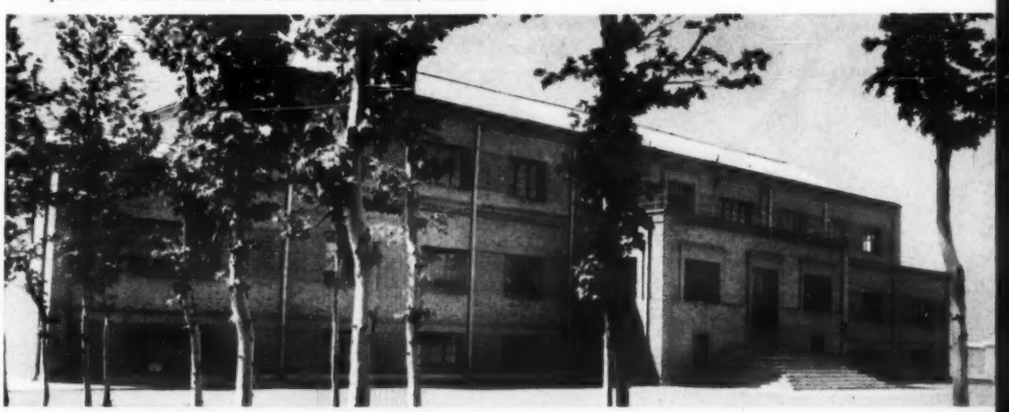
These continuous financial worries were one of the reasons for the American tour which Persia's young Shahinshaw, His Imperial Majesty Mohamad Reza Pahlavi, undertook at the end of last year. One of the major items on his agenda was to obtain an American loan of at least $100,000,000. This money was to be used for the purchase of military equipment and to raise the living conditions of the impoverished Persian masses, in an attempt to offset the very active Communist agitation in the country. The Americans refused to grant such a loan unless they could exercise effective control over its use themselves, since they are afraid that otherwise most of the money would find its way down the bureaucratic grapevine into the pockets of Tehran's corrupt officialdom. The disappointed Shahinshaw, a hard bargaining politician, is now understood to be seeking a new guarantee of Persia's independence from the Soviets. The price he may have to pay is expected to consist of new oil drilling concessions for the Soviets and other purely "commercial" agreements. The real significance of such "guarantees" would no doubt become evident soon enough . . .

Meanwhile, the Persian armed forces are doing their best to maintain a high level of military proficiency with what they have. Their equipment is relatively modern and consists in a large proportion of U.S. war surplus material which Persia bought in 1948 for $10,000,000—a small sum which procured lots of equipment at a time when war surplus stock prices had dropped to token level.

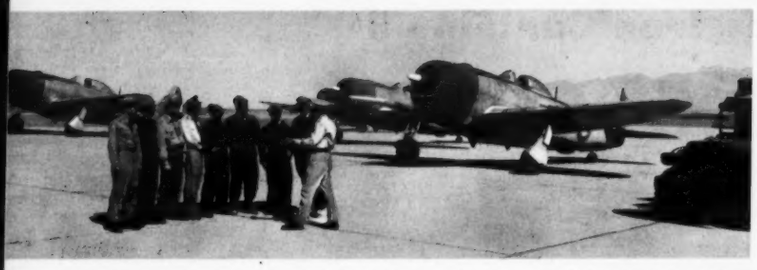
The Imperial Iranian Air Force in particular is conscious of the role it would have to play in the case of a sudden attack on the country. It would have to act as an umbrella protecting Persia's vital oilfields and petroleum refining plant pending the arrival of help from the outside.

The Persian Air Force is one of the numerous creations of Reza Shah Pahlavi, who is known as The Great in Persia. The Shah was crowned in 1926 and a year later he undertook a thorough modernization of the Persian armed forces. This reorganization included the creation of an Army Air Corps. In August, 1941, British and Soviet forces entered the country, nominally because of the Persian Government's open tendency to favour Nazi Germany in the early part of the war, but evidently also to establish that great pipeline through which enormous quantities of Ameican Lease-Lend air poured from the Persian Gulf into Russia

Headquarters of the Persian Air Force and Air Staff, Tehran.



* Cf. "Air Power Facing the Iron Curtain," "INTERAVIA, Review of World Aviation," No. 5, Vol. V., 1950.



Pilots of the F-47 "Thunderbolt" fighter squadron based at Ghali Morghi airfield are briefed before taking off on a practice mission.

Veteran de Havilland "Tiger Moth" biplane trainers are still used for primary training. These are stationed at Dowshan-Tapeh, near Tehran.

throughout the remaining years of the war. Reza Shah abdicated about three weeks after the arrival of the Anglo-Soviet forces and was succeeded by his son, Mohamad Reza Shah Pahlavi, the present ruler.

The Anglo-Soviet forces found the Persian Air Force in a high state of readiness when they occupied the country, although equipment was somewhat obsolescent owing to the country's inability to purchase up-to-date aircraft from the belligerent countries. There were five Air Regiments, composed of reconnaissance, fighter and light bomber squadrons, and the Air Force operated its own flying, observation and technical training schools.

The country's occupation resulted in the gradual disorganization and disbandment of the Persian armed forces. It was not until five years later, following a vast reorganization of all civil and military administrations, that the Air Force was able to embark on a new era of progress. During the war the young Shah had had an opportunity of observing the importance of the air arm at close hand and therefore decided to exercise direct supervision of the Air Force's reconstruction in the post-war period. He personally underwent training as a fighter pilot and obtained his wings in 1946.

Equipment

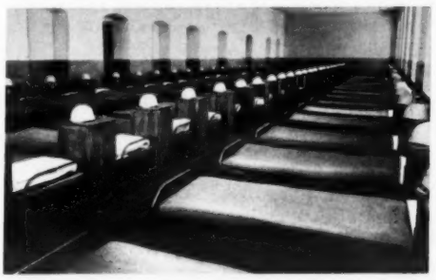
While the Army General Staff fully appreciates the potentialities of strategic air bombardment, it nevertheless wisely decided to assign the Air Force to missions lying within reach of its practical possibilities. Thus, Persia's airmen are undergoing extensive training in the tactical use of air power in the fields of air defence and the support of ground forces.

At present the Persian Air Force has about 300 tactical first-line aircraft, in addition to transport and training equipment. Fighter and ground support squadrons operate Republic F-47 "Thunderbolts" and Hawker "Hurricanes." Advanced training units are equipped with North American AT-6 "Harvards," which are also used for reconnaissance missions. Primary training is carried out with de Havilland "Tiger Moth" and Stearman PT-13 biplanes, and the transport units are equipped with Douglas "Dakotas."

Persian Air Force leaders have hopes that in view of the present world situation the Americans will speed up the delivery of aircraft under the Mutual Defence Assistance Programme and disregard the financial limits set under present arrangements. They do not expect to receive the latest American jets—merely some of the later piston-engined fighters which, after all, have again proved their value in ground support operations in Korea.

Training is one of the Persian Air Force's main preoccupations. Picture shows a class at the Air Officers' College.

Armament class a the NCO Technical Training School, near Tehran. Specialized training is given in the second year of the two-year curriculum.



Modern accommodation : one of the dormitories at the NCO Technical Training School.

Command

The Persian Air Force, although autonomous in technical and procurement matters, is under the jurisdiction of the Ministry of War and the operational control of the Army General Staff. The War Minister is *Lieutenant-General M. Yazdan Panah,* Chief of General Staff is *Lieutenant-General H. Razmara.*

Top Air Force command is exercised by *Air Brigadier-General M. Sepahpur,* one of Persia's crack military pilots. After attending the Military College in Tehran, the General left for the Soviet Union before World War II and obtained his military pilot's licence. Subsequently he followed several advanced training courses in Britian and, after the late war, attended the French Air War College.

General Sepahpur is assisted by an Air Staff composed of *four Staff Divisions.* The Chief of Air Staff is *Air Brigadier-General N. Alai,* another graduate of Tehran Military College, who received his air war training in France immediately after World War II.

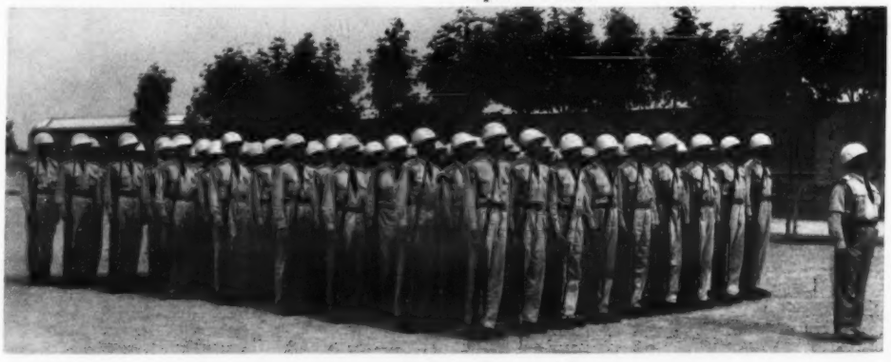
The four Staff Divisions are designated Bureau 1 (Operations), Bureau 2 (Intelligence), Bureau 3 (Personnel and Training) and Bureau 4 (Engineering and Procurement) ; they are headed by *Colonel A. Shashani, Colonel Y. Amini, Lt.-Colonel Mosaver Rahmani* and *Colonel Khosrovani,* respectively. All four officers received their specialized training with the air forces of various countries in Europe, to which they were attached for this purpose.

This team of six young officers—Generals Sepahpur and Alai and the four Staff Division Chiefs—are working together in a friendly spirit to bring the Persian Air Force to the level of other modern air arms in Europe.

Operational Units

The *combat units* of the Persian Air Force, which form the greater part of the Service, are

Pupils of the NCO Technical Training School at Dowshan-Tapeh on Parade.



Top Brass

Air Brigadier-General M. Sepahpur, General Commanding the Persian Air Force.

Air Brigadier-General N. Alai, Chief of Air Staff.

Colonel A. Shashani, Chief of Bureau 1 (Operations).

Colonel Y. Amini, Chief of Bureau 2 (Intelligence).

Lt.-Col. Mosaver Rahmani, Chief of Bureau 3 (Personnel and Training)

Colonel Khosrovani, Chief of Bureau 4 (Engineering and Procurement).

Air Brigadier-General H. Ghilanshah, Commander of tactical units.

Colonel Mostafavi, Commander of the Transport unit.

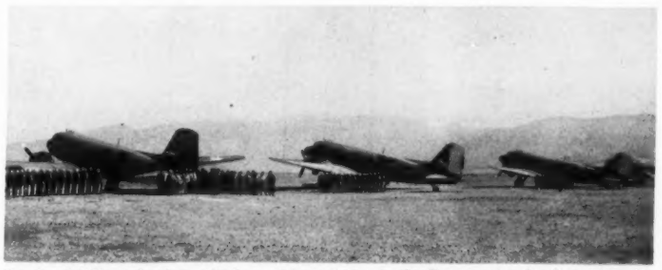
Colonel Torfé, Commandant of Air Officers' College.

Colonel Niku, Commandant of Engineer Officers' College.

Colonel A. Ajudani Commandant of the NCO Technical Training School.

Air Brigadier-General S. Siah-Pushe, Chief of Air Force Procurement.

Colonel Moini and Colonel Nafez, Air Force Inspectors.



Persian Air Force leaders attach great importance to the Transport unit whose aircraft undertake a variety of military and civil duties. The photo shows preparations for an airborne infantry exercise.

A surface transport detachment of the Persian Air Force.

commanded by *Air Brigadier-General H. Ghilanshah,* another crack pilot of the Air Force, who attended advanced flying and navigation courses in Britain and now holds the additional appointment of an Air Aide-de-Camp to the Shah.

Altogether there are seven *fighter and fighter-bomber regiments,* equipped with "Thunderbolts" and "Hurricanes." Each squadron is commanded by a Colonel.

The tactical strength of the Persian Air Force is rounded off by six *reconnaissance regiments* based at Tehran, Tabriz, Meshad, Ahwaz, Ispahan and Shiraz.

Persian air chiefs are attaching special importance to the Air Force's *transport unit* which even in peacetime is called upon to perform a multitude of missions in a country of vast size with poor surface communications. The transport unit is under the command of *Colonel Mostafavi* who studied the specialized problems of military air transportation in France and England. His headquarters is located at Mehr-Abad, on the outskirts of Tehran.

Training

Training is the principal item on the Persian Air Force's present working programme. The Service is preparing for a considerable expansion of its size and is taking care to obtain a sufficient supply of qualified officers and men in good time. The military flying training and technical schools are all situated in close vicinity of the capital. They comprise the following institutes :

1. *Air Officers' College :* Trains officer pilots and navigators, selected from students attending the Military Academy. They follow a three-year course and upon graduation are commissioned Air Force Second Lieutenants. The Commandant of the school is *Colonel Torfé.*
2. *Engineer Officers' College :* Trains officers for procurement and maintenance duties. Students are selected from University graduates (Bachelors of Science) and after completing a two-year course are commissioned Second-Lieutenants. Commandant is *Colonel Niku,* a graduate of the Ecole Supérieure Nationale D'Aéronautique, Paris.

Stearman PT-13 primary trainers complete the "Tiger Moths" of the Air Officers' Training College.

Getting a Republic F-47 "Thunderbolt" fighter-bomber ready for a practice mission.

placed at the disposal of the Allies, like all other engineering plants in Persia, and rendered them substantial services in the repair and overhaul of aircraft. Following the Allies' withdrawal from the country, the plant was handed over to the Air Force, and aircraft production on a limited scale is to be resumed shortly. At present the facility is used for aircraft and power plant overhaul. Until the factory is in full operation and has had a chance to acquire the necessary experience and production know-how, the Air Force's equipment procurement will continue to depend upon imports from abroad. Air Force procurement, which includes the Dowshan-Tapeh plant's activities, is controlled by Air Brigadier-General S. Siah-Pushe, who obtained his engineering training in France, Britain, Sweden and the USA.

Inspectorate

The activities of the Persian Air Force are supervised by a separate Inspectorate Section reporting direct to the Chief of the Air Force. The Section is headed by two Inspectors and

A wireless training class at the NCO Technical Training School.

3. *Advanced Officers' College:* Provides advanced tactical and engineering courses for graduates of the Air and Engineer Officers' College.
4. *NCO Technical Training School:* The duty of this school is to provide the Air Force with non-commissioned officers familiar with modern equipment as it is delivered to the Service. After a one-year general course, candidates take a specialized course of similar duration in airframe engineering and maintenance, aircraft power plant, armament, hydraulics, radio, etc. The school is commanded by *Colonel A. Ajoudani*, graduate of several French engineering colleges.

In addition to training at home, a considerable number of Persian Air Force officers are at present attached to air forces in Europe and the USA for special training.

Procurement

Prior to Persia's occupation by the Allies, an aircraft manufacturing and repair factory was set up at Dowshan Tepeh under the name "Shabaz." Manufacturing licences for two types of aircraft were acquired for it before the war. Under the wartime Anglo—American—Russian occupation the factory was

Headquarters of the Air Surgeon's section. The "health centre" comprises a hospital and various testing and research installations.

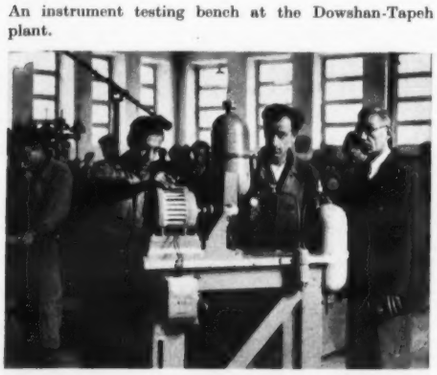
divided into sub-sections for finance, operations, training, transport and health.

*

Persia's Air Force is fully conscious of the role it has to play in the defence of the country's rich mineral resources against the greed of some of its neighbours. Its leaders are young, well-trained and ambitious and are concerned not only with the expansion of their service but take a deep interest in the progress of the economic situation of the country as a whole for they are aware of the fact that only an economically sound nation can be strong enough on the ground and in the air to provide efficient protection for its actual and potential wealth.

Dowshan-Tapeh aircraft factory: one of the engine repair shops.

An instrument testing bench at the Dowshan-Tapeh plant.



Republic F-47 "Thunderbolt" fighters of the Persian Air Force "bedded down" for the night.

Hey, Soaring Enthusiasts of 1950 !

The Oerebro Sailplane Championships, July 3rd to 16th

BY HERMANN SCHREIBER, BERNE

The flags of the nations accompany the first Soaring Olympics—no Gordian knot had to be unravelled over any specification concerning the amateur status of participants.

"Hey," calls the Swede when he meets you in the street, just like the American says "Hi" or the Briton "Hello." The friendly "hey" was the motto of the 1950 gliding event at Oerebro, Sweden.

The *Fédération Aéronautique Internationale* was well-advised when it invited the *Kungl. Svenska Aeroklubben* to organize the first World Sailplane Championships. The Swedes turned the event into a regular soaring festival. Twenty-nine pilots from eleven countries met to show what sailplane flying can be. Under the expert management of the Swedish Air Force and watched by an enthusiastic population, the competition was held fairly and without a hitch.

Major-General P. af Uhr opened the meeting with a few kind words for the soaring pilots of all countries in the world, the "Bohemians of the Air," who have at last been accepted by "society." May the best man win, said the General, and the best man did win after a protracted but very fair struggle. Any one of the first five might have been the world champion, but in the end it was the *Swede Billy Nilsson who won the honor.*

Billy Nilsson, soaring champion No. 1 and pilot by passion.

The championships were based on the performance of each individual, and no classification of winning teams per nation was made. Nevertheless, the averages obtained by the teams indicate the rank held by the various countries. The list is headed by the Swedes, the USA and, as the great surprise of the *Världsmästerskapstävlingarna* (World Championship to you), the bravely battling Yugoslavs. There followed Finland, Denmark and France. "Also-rans" were South Africa, Holland, Britain, Norway and Switzerland. Unfortunately the five Polish entrants had to stay away at the last moment "for technical reasons," probably because their aircraft were caught in the meshes of the Iron Curtain.

The Swedish Air Force's attitude towards soaring and gliding is exemplary. It uses sailplane flying to teach its members a kind of "social etiquette" in their dealings with winds and clouds. The Dutch, methodical as ever, employ gliding to provide their pilots with a sont of elementary education. In Switzerland, too, the prospective jet pilot must learn his landing technique on a glider before he is allowed to take off in a "Vampire." But the majority of the pilots at the meeting were enthusiasts who are soaring pilots because they like it, because they think that flying is wonderful. They are individualist seeking freedom in the air.

From a technical point of view, the old German soaring tradition marked the meeting. Six countries used the "Weihe" high performance sailplane and two the "Meise." Only the French had brought nothing but aircraft

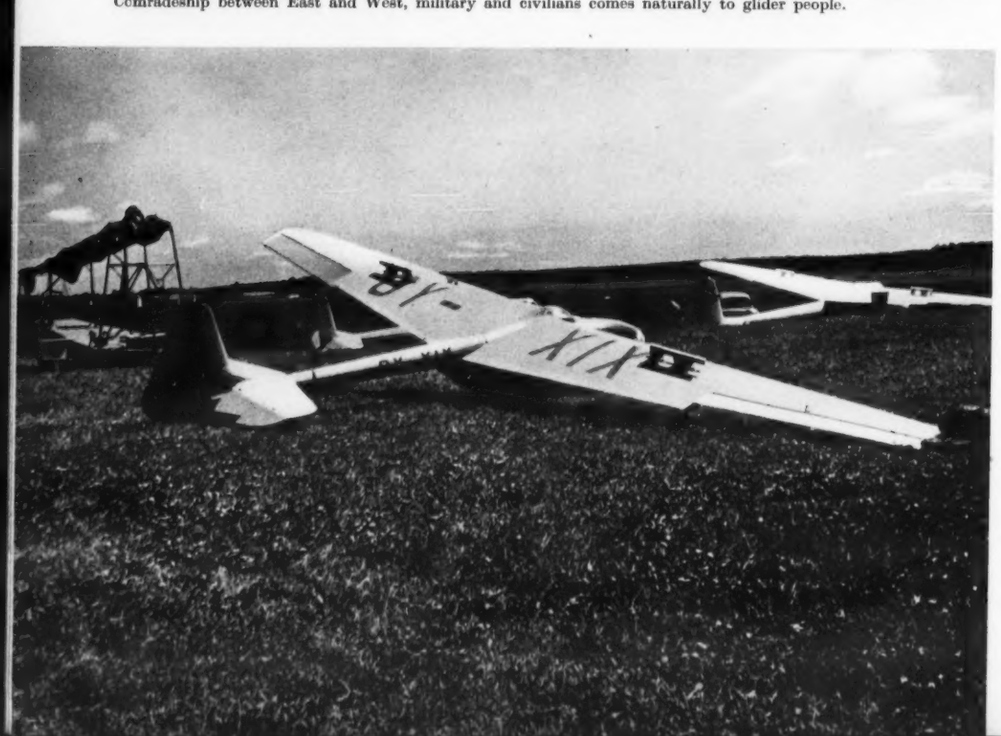
The Yugoslav *Arbajter* showed in masterly fashion how the "Weihe" is landed at its fixed destination. The sky is full of cumuli.

The Arsenal "Air 100" was used not only by the French but also by the Swiss and the South Africans.

The first glider stalks a small thermal cloud : if he can maintain himself there, the whole fleet is immediately towed into the air.

The "Bréguet 900," which is fitted with camber-changing flaps, holds the French distance record of 292 miles. Unfortunately this interesting new design was eliminated early owing to damage to the fuselage.

Comradeship between East and West, military and civilians comes naturally to glider people.



The Danish FI-1, originally designed as an aerobatics glider, surprised by its excellent performance.

of their own design, namely, the "Air-100," which evidently is based on the "Weihe," and the "Bréguet 900," which features camber-changing flaps. The Yugoslavs brought along their elegant "Orao II," a real antelope of the clouds, with which its pilot, *Borisek,* won a well-deserved third prize. Up to about 55 miles per hour the "Orao" seems to be about equal to the "Weihe," and at higher speeds it is quite obviously superior. *Georg Müller,* the Swiss designer, could claim the distinction of being represented by three of his own models, the "Moswey III," which is especially suited for glider flying in the Alps; the "Moswey IV," a fast and aerodynamically very clean aircraft; and the "Moswey VI" two-seater. Müller, who builds his aircraft without receiving a cent of subsidy from the government, is a designer by conviction.— The British brought along their well-proven "Gull IV," the Danes tried their luck with the "Hütter 28," the smallest aircraft taking part in the championship, and with the "FI 1," a sailplane of their own design. The latter must be regarded as an experiment of considerable originality. The wing unit is that of the "Meise" but shortened by one meter (three feet), the pilot nacelle is a steel tube structure covered with a plywood skin, and the tail unit is borne by a conical plywood tube.

At nine o'clock every morning the pilots assembled around the chief of the championship, *Colonel C. O. Hugosson.* Attentively, as at a religious service in the field, they listened to the weather people and studied the pattern of the isobars. Cleverly adapting their plans to the prevailing meteorological conditions, the management of the contest each day decided on the events to be held and cleared the aircraft for the take-off. Indefatigable assistants in the meantime assembled the sailplanes and towed them past the flags of the eleven participating nations to the airfield. The spotless uniforms of the Swedish Air Force personnel and the pretty Lottas, the bright colours of the elegant feminine spectators and the graceful sailplanes made a fascinating picture.

Stage fright, regular occurrence at horse shows and similar events, is unknown at an airfield. The mechanics and assistants perform their services rapidly and almost noiselessly. The acoustic element is provided by the roar of the tugs warming up their engines. Everything functions according to plan, though nobody has taken the trouble to organize himself to death. The pilots are dressed in their life jackets by their aides and strap on their parachutes. All aboard! The slight ticking of the barograph mingles with the low hiss of the oxygen turned on for checking purposes. The electric gyros of the blind-flying instruments begin to hum, the radio is switched on. Close at hand are maps, iron ration, first aid kit and signalling equipment. Here and there a mechanic massages wing leading edges and parts of the tail with mysterious liquids and pastes as a precaution against ice formation in the clouds. Static conductors at the wing tips and the tail unit protect the aircraft against the effects of lightning. Pressure suits are not in use as yet, but means of protection against

extreme temperatures have already become a problem. The most important equipment, which is not visible and the quality of which is demonstrated only when performances are calculated, is the pilot's brain : his knowledge of the distribution of air currents, updraughts and downdraughts, his airmanship and his experience in instrument flying. Frequently he will have to resort to intuition when groping for his way, and very often it will be only by rapid, energetic decision that he will prevent a sudden loss of height and regain his contact with an updraught. Soaring pilots are romantic technical experts, handicraft and science must remain in close contact.

The tug aircraft and their charges now take off in rapid succession. Just below the cloud base the sailplanes release their towing cables, begin to search for a suitable updraught and spiral upwards until they disappear in the "muck." The sailplanes are the terror of the air traffic control people. It is to be hoped that radio equipment will finally keep them from becoming a "cloud pest" along the airways and in the approach zones.

"Fröken Segelflyg," the charming assistant of the Norwegian team.

Within less than an hour the whole "field" of soaring contestants was hanging in the sky and disappeared behind the clouds. The cars of the ground crews followed their aircraft in the selected flight direction, and in this pursuit the radio-telephone equipment carried by some of the participants demonstrated its considerable usefulness. Not only was it possible to report one's position whenever needed, but pilots and ground crews continuously exchanged observations regarding air currents. The result was that pilot and aircraft could be picked up within an hour after landing and transported safely back to Oerebro. Crews without radio-telephone were forced periodically to call the take-off point to find out if their pilots had landed. Much time was wasted in the search for the landing spot and the transport back to base—time which the pilot could have spent in beneficial rest.

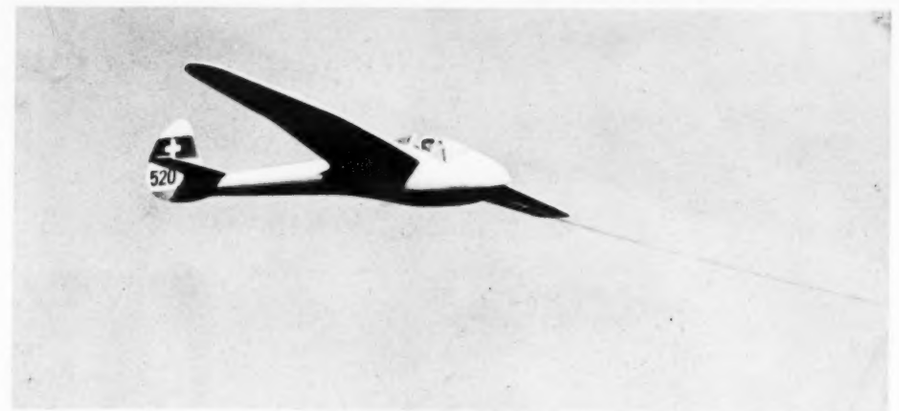
Throughout the contest the weather was on its "Sunday" behaviour. There were no phenomenal fronts and towering clouds reaching up into the stratosphere. As a result, no sensational performances were achieved, but the contestants showed the good use to which they could put even moderate air currents. *MacCready,* an American university student, surprised everyone with the good average speeds of his flights : on his fixed destination flight he averaged 53.2 m.p.h., so that he was suspected of using special glasses to "see" the air currents he needed. *Alm,* the Swede, attained an altitude of 10,000 feet above his release point. The champion, *Wilsson,* still was in second place behind MacCready on the last day but one. In the last event he staked everything on one card and announced that he would fly to Oestersund. Unluckily and luckily at the same time, he landed about 2,500 feet short of his destination. But with a flown distance of 267 miles he secured first place ahead of MacCready and also attained the best distance average of the whole contest. His victory was well-deserved.

Of special interest to soaring experts was the fifth day of the competition. Cumulus conditions and easterly winds prevailed. MacCready flew south and had to land north of Kristianstad after covering 203 miles. The Dame *Rasmussen* turned his "FI 1" north and flew 155 miles to a point directly on the Norwegian border. The two spots are separated more than 340 miles as the crow flies.

The social aspect of the meeting suffered somewhat from the intense preoccupation with flying, towing and surface transport. The days of rest had to be used to groom the aircraft. In a modest corner of the hotel lobby OSTIV (*) had set up its field headquarters. This organization, whose task it is to sponsor the technical and scientific development of gliding and soaring flying, met to listen to a number of papers. Active pilots and crews unfortunately were prevented from attending. In a fresh and uncomplicated spirit the American Dr. Raspet brought new life to the organization. Hence there is a hope that OSTIV will ultimately regain the past glory of ISTUS.

The next soaring championships may be held in France. Although the organizers may take over the contest regulations of their Swedish predecessors practically without a change, it might be worth while to study the possibility of introducing a classification according to teams. Also, a speed event over a circular course might be included in the list of competitions. Destination flights with return to base seem to be unlikely owing to air safety considerations.

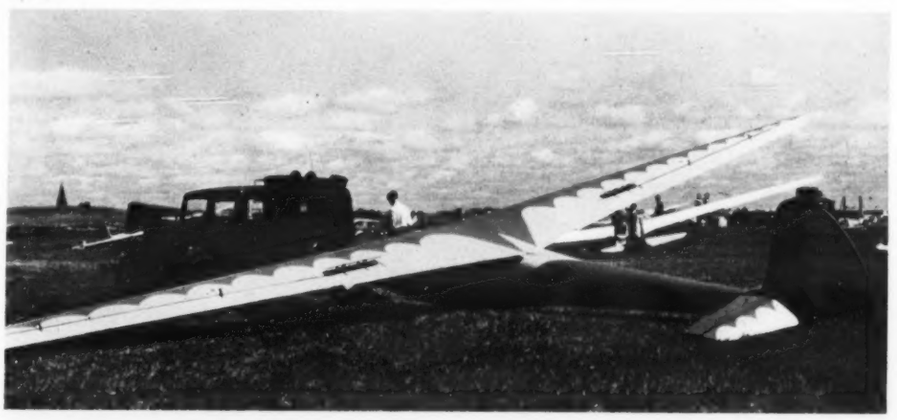
At Oerebro the contestants accumulated a total flying time of about 800 hours and covered 20,000 miles on their distance flights. Contrary to expectations there was really little breakage. The insurance companies will rejoice in the thought that the whole series of events took place without serious accident.



The Swiss-American René Comte took part in the competition with the relatively untried "Moswey IV" prototype and attained promising results.

* OSTIV stands for "Organisation Scientifique et Technique du Vol sans Moteur." Headquarters is in Paris.

The "Weihe" was used with good results also by the British team. It has taken over the role of the "Olympia-Meise."



Swissair Shake-up

A Special Case—But Typical

What was Wrong?

The thing seemed screwy. The financial crisis of an airline such as Swissair, which is of no outstanding importance in the world's economy and air transportation, provoked a resounding echo in the far corners of the earth. The reasons for this interest are comprehensible : Switzerland, with all her institutions, is renowned as a model of stability and good order, as a little *Rocher de Bronze*. And Swissair ? Small, but good, like a Swiss watch. On its Board of Directors staid, dignified representatives of the ancient Swiss cantons rub elbows with industrialists, bankers and businessmen. These people personify Switzerland's three national monuments : lofty peaks, dreamy lakes and the Swiss franc.

Yet, a crisis was inevitable.

Officially the little drama began on September 23rd, 1949, when the shareholders of Swissair met to discuss the proposed purchase of three costly Lockheed 749 "Constellation" long-range transport aircraft. The deal was approved, but it never went through. The reason was that a few days before the meeting the devaluation of most of Europe's currencies had blown the company's budget plans sky-high. The opinion has since frequently been expressed that Swissair's dilemma merely was a consequence of that devaluation. This is not quite true : while there is no doubt that the devaluation was an important contributing factor, all it did was to bring the crisis to a head. The crisis itself was inevitable. The example of Swissair is typical.

Swissair has always been managed on strictly business lines. Before the war, notably at the beginning of the 'thirties, it acquired a reputation which was outstanding for its small size. It operatd efficiently : in effect, above the average. It was the creation of a triumvirate of men who died all too soon : the chief of the Swiss Federal Air Office, Colonel Arnold Isler, and two capable Managing Directors, Balz Zimmermann and Walter Mittelholzer. Swissair was the first company in Europe to adopt American high-speed aircraft ; it was one of the world's first airlines to send its pilots to Germany to study the blind-flying methods introduced by the German Lufthansa. It was one of the first airlines which realized that air transportation would not be able to live off State subsidies "until the cows come home," that civil aviation would have to become a practical means of transportation one day and that it would have to be run on economic lines. This insistance on economic self-sufficiency characterized Swissair's pre-war balance sheets like a red thread and even after the war remained the fundamental principle of the company's policy.

During the war years Swissair was practically inoperative, as the country was surrounded by belligerent nations. But immediately after the cessation of hostilities, Swissair quickly reconquered an honourable place in air transportation. True to Swiss tradition, there was nothing hasty about this development. It took protracted meetings to increase—or "dilute"—the company's share capital from Sw. frs. 1,000,000 to Sw. frs. 20,000,000. The increase was necessary to face the company's post-war requirements. But the axiom of economic self-sufficiency continued to guide the company's operations.

Swissair's personnel was gradually expanded from 150 to 1,500.

Swissair Operating Statistics

	1938	1946	1947	1948	1949
Aircraft miles	921,987	1,536,900	2,551,480	3,867,900	5,350,690
US ton-miles offered (000's omitted)	1,735,596	3,362,711	7,316,459	11,516,304	16,702,939
Load factor	55.5%	85.4%	70.1%	61.0%	55.3%
Passenger miles	8,116,370	24,676,600	42,972,200	58,009,400	75,810,400
Passengers	32,622	61,455	93,822	113,622	153,812

Pioneers of Swiss air transportation (left to right) : Walter Mittelholzer, and Balz Zimmermann, Managing Directors of Swissair from 1931 to 1937 ; Colonel Arnold Isler, first director of the Swiss Federal Air Office.

An Engineering Manager, Dr. Gottfried von Meiss, a lawyer and general staff officer, was appointed to assist the commercial manager. To mark the growing importance of the national airline, the Chairman of the Board of the Swiss Bank Corporation, Dr. Rudolph Speich, was elected Chairman of Swissair. The Board of Directors was expanded to 27 members, which perhaps was a little exaggerated but in return comprised a number of prominent figures from Swiss administration and economic and industrial circles.

The next step was to expand the air fleet. During the time of Colonel Isler the company's equipment policy had been progressive, even daring : new, practically untried aircraft had then been placed into operation with much luck and success. But this time the management wanted to make sure. Initially, it contented itself with twin-engined Douglas DC-3s and with an order for four Douglas DC-4s, literally the last of the production series of that type. With a little more pluck Swissair might have ordered the more-advanced Douglas DC-6 or Lockheed "Constellation." Safety first was the motto, however, also as regards the bank account. The post-war air fleet was completed by a contract for four "Convair-Liners." Last but not least, the company established a stock of spares and spare engines which somehow or other was out of proportion to both the share capital and the air fleet. The report for 1949 showed the entire air fleet at an insured value of Sw. frs. 25,000,000, while the insured value of spares amounted to no less than Sw. frs. 17,000,000. These spares were intended for an air fleet of wich the majority, after all, consisted of obsolescent equipment.

A brief study of Swissair's crisis, which today may be regarded as overcome, explains the situation. The devaluation of the European currencies quite obviously was the *causa causans* of the company's near-collapse, since most of Swissair's operations are conducted on

Dr. Rudolf Speich, Chairman of the Swiss Bank Corporation, was elected Chairman of the Board of Directors of Swissair after World War II.

inter-European routes to countries whose currencies were devalued. In the procurement of spares, on the other hand, the company obviously bit off more than it could chew. Furthermore, Swissair's voluntary or involuntary renunciation of subsidies and the not very imaginative policy of the Swiss Federal Air Office also were powerful factors in bringing about the crisis of the Swiss national airline. At any rate, its extremely conservative operating policy and somewhat backward equipment policy did not afford the company any protection.

The Way Out

Private enterprise, careful management and an equipment policy based on past tradition were incapable of keeping Swissair out of trouble. Like all the other airline companies in the world it had to adopt new methods in the somewhat unstable post-war situation. In this respect Swissair's case is typical. In others, it is peculiar.

When similar crises occur in Holland, Britain or in America, the management addresses itself to the State, the banks or the insurance concerns. Following negotiations behind closed doors, a press release is issued and the case is more or less settled. Swissair did not have that luck. Foreigners may consider the proceedings strange, but the Swiss citizen regards it as absolutely normal. Switzerland is really a democracy. If a municipality or a canton thinks of building a new schoolhouse, the project must be put to a vote. Hence it is easy to imagine what happened when it became known that the Swiss flag air carrier suddenly had run into difficulties, that it wanted thirty or forty million Swiss francs for reconstruction and that it had appealed to the

Eugen Groh, Swissair's Commercial Manager.

Dr. Gottfried von Meiss, Technical Manager.

Federal Government for help. The administration, the Council of States, the National Council, the Cantonal Governments, banks and industry, the entire Swiss press, even the peasant tilling his field at the back of a mountain, suddenly found themselves discussing air transport problems in the feeling that they, too, had a say and a share in the responsibility. Those who were really harrassed were the management and the members of the Board of Directors. For about nine months they were practically in permanent session. Suddenly the national pride of the Swiss won out: Berne, the Federal capital, decided to take a hand, especially since the amount involved was of no importance to Switzerland's national economy as a whole.

The shake-up of Swissair's organization included a search for a "strong man" to be charged with the duty of coordinating the technical and the commercial managements of the airline. It was suspected that there was some kind of a weakness in the liaison between the technical and the commercial departments, since it was unusual for a company to disclose financial difficulties and yell for new aircraft at the same time—precisely what happened in September, 1949. The right man was found in the person of a member of the Board of the Swiss Federal Railways, Dr. Walter Berchtold, who was appointed Managing-Director and asked to cooperate in the reconstruction of the company and subsequently to assume its overall management. It is understood that the Federal Government has given assurances to the effect that the company will continue to exist and will be given every opportunity to expand. After the Parliamentary holidays in September, 1950, reconstruction plans will be determined.

Dr. *Walter Berchtold*, Swissair's new Managing Director, who before his appointment with the Swiss national airline had been an administrator of the Swiss Federal Railways, brings with him years of experience as a legal expert on transport matters. A difficult and responsible task lies ahead of him, despite the guarantee recently given by the Swiss government.

The decision, taken after protracted negotiations, to purchase two Douglas DC-6B airliners is a pointer to the kind of assistance which Swissair may expect from the State. It seems that the company will no longer have to straggle behind other international operators in the quality of service it can offer.

At first sight the case of Swissair looked more serious than it probably has ever been. The affair is regarded from a more normal point of view today, and the people concerned have regained their old sense of humour.

An edifiing spectacle was offered by the aircraft sales representatives. If it is considered that the business at stake for the time being involved two, repeat two, complete aeroplanes, the fantastic efforts expended by the industry looked a triffle absurd. Hour by hour the competitors, Boeing, Lockheed and Douglas, undercut each other's offers. And one of the Douglas men is reported to have said at the end of the final all-day and all-night conferences that it might have been cheaper to give the aircraft away...

What about the Swiss press? It got wind of the whole affair in time, and one local wit reported the following fictitious conversation a few months ago: A: "It's incredible how Swissair is taking off again"! B: "What do you mean? is it operating jet transports"? — "No," said A, "it is flying with subsidy propulsion and automatic deficit cooling."

Isn't the case of Swissair typical? The principle of self-sufficiency in transportation is a real problem. In Twentieth century air transportation more than ever before.

From Swissair's 1949 Report

Revenue (Sw. frs.):		
Passengers, Freight, Mail.		34,765,806.73
Other Operating Revenue		4,411,945.41
Miscellaneous		1,816,944.11
	Total	40,994,696.25
	1948	(35,416,126.20)
Expenditure (Sw. frs.):		
Salaries of Crews and Technical Personnel, Fuel and Oil .		15,233,884.60
General Operating Expenses		9,615,373.85
Staff Insurance, Pension Fund, etc.		1,631,139.56
Operating insurance		2 368 709,98
		28,849,107.99
Management Expenses		8,773,241.30
Advertising and Publicity		730,526.92
Depreciation		6,327,258.20
	Total	44,680,134.41

Swissair Headquarters in Zurich.

Military Contract Operator

The Unusual Activities of a Swedish Charter Line

A civil contract air carrier operating first-line combat aircraft certainly is an improbality among the world's hundreds of irregular airlines. Such a company exists, however, and it is doing well.

Towing targets to be shot at with live ammunition is a task which normally is assigned to military aircraft flown by military crews on behalf of military training organizations. Sweden provides the exception. At the outbreak of World War II the Swedish Government decided that the relatively limited combat manpower of the Swedish Air Force should concentrate strictly on increasing its own military prowess and on guarding the country's neutrality. And even after the cessation of hostilities the Air Force continued to be extremely busy : the war had confirmed the theory that a strong air arm was the most important single factor in the defence of a nation, and the Swedish Government consequently ordered a rapid expansion in the Air Force's post-war strength.

The management of Svensk Flygtjänst AB *(left to right)* : Erik Lindahl, Chairman of the Board ; Commander B. J. Hurren and Major Maurice Wright, of Fairey Aviation Co. ; Tor Eliasson, Founder and Managing Director of Svensk Flygtjänst ; Hugo Fredrikzon, Chief of Operations ; Bengt Lindberg, of Svensk Flygtjänst. Picture was taken at a recent target towing demonstration at Ska-Edeby Airport, near Stockholm.

De Havilland "Moth Major"

Caudron "Pelican"

Miles "Falcon"

Junkers W. 34

Fokker CVE

Arado Ar 95

Fiat CR 42

Miles "Martinet"

Fairey "Firefly Mk. 1"

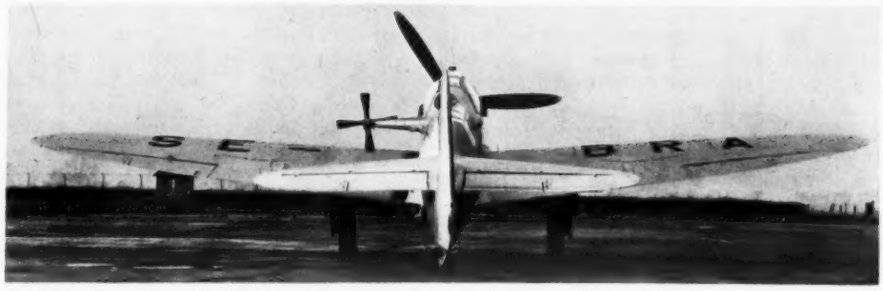
The Fairey "Firefly Mk. 1" target tug originally modified to the specifications of Svensk Flygtjänst AB. The Company is operating a fleet of eleven aircraft of this type.

The "outbreak of peace" at the end of World War II was not sufficient to persuade the Swedes to disband their anti-aircraft units. *Flygtjänst* therefore found that instead of reducing its operating strength it had to modernize its fleet of target tugs. To begin with, the Company bought twelve Fiat CR 42

Shortly after the outbreak of war the Swedish Government had taken the initiative to relieve the Air Force of the duty of towing targets for the Army's and the Navy's anti-aircraft gunnery training. Contracts to carry out this work were awarded to civilian operators. Today *Svensk Flygtjänst AB,* a Stockholm private charter company, holds a monopoly of "professional" target towing in Sweden. While a kind of "amateur" target flying is carried out by local flying clubs, *Flygtjänst* is the only Company with nine years of experience in this particular field. It successfully operates a fleet of sixteen modern target tugs—with a total payroll of only 70, including administrative personnel, which certainly is a record.

Established in 1935 chiefly for the purpose operating a flying school and carrying out charter flights, the Company added military target towing to its activities when the Government awarded contracts to civilian operators. During the war period anything that had wings was pressed into service to tow targets for the Army and Navy and to carry out miscellaneous transport duties for the two Services. By the end of World War II *Svensk Flygtjänst* possessed a motley fleet of 27 aircraft. Flying hours accumulated during the war were 20,800.

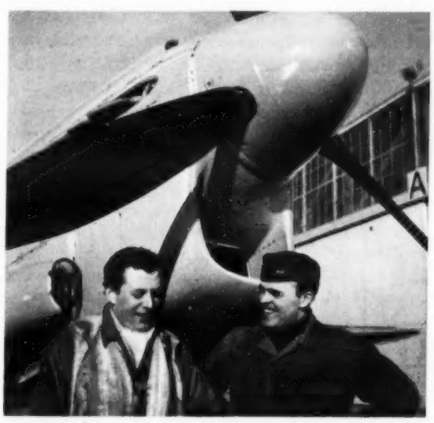
The windmill device on the "Firefly," a simple system controlling the length of the wire towing the target glider. The windmill is in the "off" position.



To reel in the towing wire, the windmill is placed into the airstream.

surplus biplane fighters (designated J 11 by the Air Force) which had long been obsolete and were discarded by the Air Force in 1944. In 1946 a specially-designed target tug, the Miles "Martinet" single-engined two-seater powered by a Bristol "Mercury 30" engine, a modification of the Miles "Master" advanced trainer which had done yeoman service during the War, was bought.

As it gradually became evident that the post-war prospects for non-scheduled operators were by no means as good as had been optimistically forecast in 1945, *Flygtjänst* decided to abandon most of its charter activities. One reason was a hangar fire at Bromma



A typical target towing crew: Tage Pettersson, pilot, and Jan Olofsson, mechanic.

Airport, Stockholm, which destroyed two of the Company's twin-engined transports, a de Havilland "Dragon Rapide" and a Fokker F XII. Giving effect to this decision, *Flygtjänst* purchased eight more "Martinets" in England. Although the "Martinet's" towing speed and general target tug characteristics were superior to those of the old Fiat fighters, the Army and the Navy soon raised their requirements.

These requirements called for a combination of several qualities. Aircraft had to be *reliable,* since any interruption would cause costly wastage of time in the training of a large number of gunners; they had to have a *low maintenance factor,* since they had to stay in operation for prolonged periods during the summer months; finally, *endurance* had to be good, since the aircraft were required to remain over the target area sufficiently long to exercise the gunners adequately.

As no target towing aircraft capable of meeting these exacting requirements could be bought off the shelf, a survey covering all aircraft which could possibly be converted into target tugs was carried out by the Company. The result was that the Fairey Aviation Company Ltd. was approached with a proposal to modify four "Firefly Mk 1" reconnaissance-fighter aircraft into target tugs. Not only had the "Firefly 1" an 1850 h.p. Rolls-Royce "Griffon 12" engine giving it a design towing speed of nearly 300 m.p.h., but it also provided an almost unique answer to operational towing problems. It originally was developed as a carrier-based aircraft and consequently offered a remarkable degree of control throughout its speed range. It was able to operate from small airfields, and its all-weather qualities, demanded by marine operations, were an important additional advantage.

The first "Firefly 1" target tug was delivered on Christmas, 1948. The other three followed in the Spring of 1949. A repeat order for another seven was placed in the Spring of 1950.

Flygtjänst's target towing activities, two-thirds of which are for the Army and one-third for the Navy, are now carried out with sixteen aircraft, including eleven "Fireflies" and five "Martinets" (two "Martinets" have been retired and will be cannibalized for spares). Experience with the "Firefly" has been good, which is shown by the fact that during the summer months of 1949 the four "Fireflies" then available accumulated more than 1,200 flying hours. In the period from January 1st to September 30th, 1949, *Flygtjänst* target tugs flew a total of 3,067 hours from eight stations stretching from Malmoe in the South to Lulea in the North.

To make firing practice as realistic as possible, *Flygtjänst* issued specifications for a target glider type simulating an enemy aircraft to replace the primitive sleeve or banner type targets used perviously. A number of gliders of a type developed in Britain during the latter part of the War was acquired from the RFD Company Ltd., Godalming, Surrey. These targets had a span of 16 feet and were built of metal covered with fabric. In order to reduce the costs involved in the replacement of targets, *Flygtjänst* in 1947 decided to ask the RFD Company for an all-wood target glider. The company built such a type, but subsequently it was modified by Olle Bulow of *Flygtjänst* so that damaged wings could be replaced. Known as the VM 3, this target glider has been used successfully since 1948. With the VM 3 target the "Firefly" has a maximum permissible speed of 259 m.p.h. at 3,000 feet above sea level for an endurance of three hours, of 270 m.p.h. for one hour, and of 290 m.p.h. for brief periods. More than 150 VM 3s have been built to date.

The first target glider built in quantity in Sweden was this VM 3, a modification of a British model. It has detachable wings. Maximum towing speed is 298 m.p.h. About 150 have been built to date.

The VM 4 target glider designed and built for the Royal Swedish Air Force's air-to-air gunnery training. The glider, a small batch of which is now being delivered, is of twin-boom configuration and has a span of thirty feet. It has been successfully tested, towed by a "Firefly," at speeds of up to 280 m.p.h.

A Miles "Martinet" taxis in after a target towing mission.

As a by-product of this activity, *Flygtjänst* found that the sale of these gliders could form a profitable source of revenue, and for this purpose the Company established a separate firm in 1948 to market the targets. The Company is known as *AB Flygmal.*

The target glider activities of *Flygtjänst* were watched closely by the Swedish Air Force. As a result it ordered the design and construction of a larger target glider for air-to-air gunnery training by modern aircraft. Designated VM 4, the new model has a 30-foot span and a twin-boom configuration. It has just been tested successfully, towed by the "Firefly" at speeds up to 280 m.p.h. A small batch is now being delivered to the Air Force for testing, towed by a modified SAAB 18A (S 18) twin-engined reconnaissance aircraft.

The glider's towing is controlled by a simple windmill device. The target is towed at a distance of about 250 feet from the tug at take-off, and the tow is then lengthened to between 2,000 and 3,500 feet, depending on the type of exercice which is to be carried out (with increasing altitude and larger gun calibres the towing wire is obviously extended). The maximum towing length is about 6,500 feet. If the target has not been shot away by the end the exercise, the tow wire is reeled in until the glider is closely astern of the aircraft. When the glider touches the ground, the wire is cut by the operator in the rear cockpit, allowing the glider to come to rest on the field.

Among a number of interesting experiments now being carried out by *Svensk Flygtjänst* is the testing of SAAB's new BT-13B hit-indicator consisting of a microphone housed in a streamlined aluminium casing, which is attached to the target. It is connected to a recording apparatus in the tug aircraft. The membranes of the microphone react to the air pressure waves set up by the projectiles when they pass through the "hit zone" of the target. Each impulse is transmitted from the microphone through the towing cable to the recording apparatus in the tug, where a counting mechanism enables the number of hits to be read through a small panel in the apparatus.

The Company in addition conducts experiments with radar gunnery training in bad weather or at night. This will necessitate preparing the glider targets with some kind of metal covering to make them register on the radar screens of anti-aircraft batteries.

The success of *Svensk Flygtjänst* has generally been acknowledged in Sweden. It has been impressive enough to induce Norway and Denmark to consider plans for the organization of their own target towing activities along similar lines.

A Good Thing He Was Broke

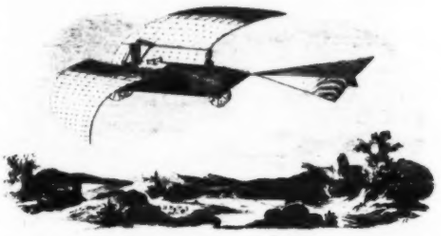
A German pioneer of the mechanical age, Werner von Siemens, wrote in his memoirs, published in 1892 :

> "There is no doubt that we can build flying machines imitating the flying animals the moment we fulfil one prerequisite, namely, to construct machines which are as light and robust as the principal muscles of these animals and whose fuel requirements are not very much greater than those of these animals. Once the first such machine has been invented, any capable mechanic will then be able to build a flying machine. However, inventors always put the cart before the hose and design flying machines without having a suitable sort of motive power at their disposal."

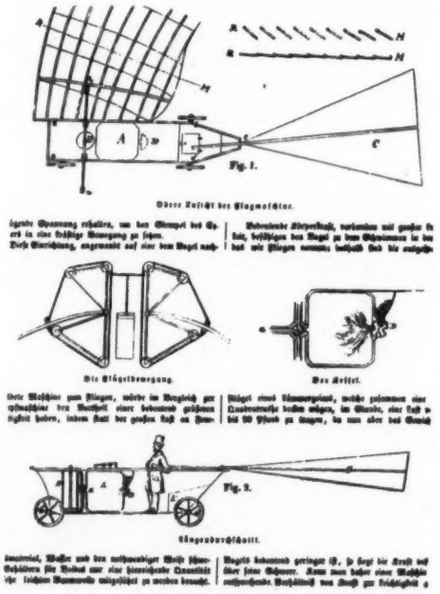
This somewhat complicated statement epitomizes the misery which the first "engineers" who tried to build aircraft must have felt in the middle of the Nineteenth Century. Even serious trail-blazers, such as Hensen and the mechanical genius Stringfellow, were incapable of conceiving the use of a power plant other than the steam-engine. This is no miracle if it is considered that the first locomotives—suspiciously watched from a distance—were then racing around the scenery over distances measuring between thirty and sixty miles.

It is all the more notable that as early as the 'Forties of the Ninteenth Century a few clear-sighted pioneers foresaw the advent of the internal combustion engine. But with their entirely inadequate industrial equipment they never succeeded in materializing their idea, though the principle of the latter was perfectly sound.

It is to be regretted that no record is left of the name of the silk-hatted gentleman whom our picture shows flying over a romantic landscape. Tales without full names and addresses apparently lose much of their authenticity, interest and significance. All that is known about the gentleman is that he was a German officer who in issue No. 189 of the "Leipziger Illustrierte" of 1847 informed his readers that he intended to carry out flights with a flying machine he had designed... provided he could find someone footing the bill for his construction and operating costs.



Ready on paper : These pictures from the "Leipziger Illustrierte," issue No. 189, 1847, show the project for a "flying machine" which should have been propelled by gun cotton but was never built.

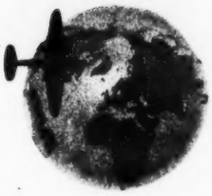


The gentleman with the silk hat knew what he wanted. His description of the machine, which included extremely neat construction plans, states that the inventor intented to fly "by means of gun-cotton." Through explosions in a combustion chamber, suitably regulated by a pedal, a "pestle" was to have been brought into motion, which in turn was to have actuated the wings by provoking a "vigorous flapping movement" of the latter.

> "This arrangement, applied to a flying machine bearing a rough resemblance to a bird, would have the advantage of much greater lightness than devices powered with steam-engines. In place of the great weight of combustion material, water and the necessary boilers, the only load to be carried would be an adequate quantity of extremely light-weight gun-cotton."

The passenger and power plant nacelle of the aircraft was designed as a basket, the fragile front and rear wheels certainly did not weigh much, and the gentleman with the silk hat looked like a bantam weight himself. Things should have worked, therefore. Everything was ready, except the question of finance. No sponsor showed up, and the inventor remained anonymous. He ought to be congratulated, for even if his "flying machine by means of gun-cotton" had been incapable of rising into the air, no doubt it would have sufficed to break the pioneer's legs or neck.

F.-K. M.



What's in the Air? *

CLEARING THE DECKS

The events in Korea — in which the Koreans themselves are playing a passive rather than an active rôle — seem to have come as a shock to the authorities planning the defences of the Western World. But the Western military machine is now gradually gathering momentum.

In reality, the leading military of all Atlantic Pact nations have insisted on the adoption of certain security measures since long before the outbreak of the Korean conflict. These measures seem to have been discussed in every detail and should be ready for enforcement. Particularly emphatic was the warning expressed on June 5th by *General George C. Kenney*, Commandant of the USAF Air University, who declared in Detroit that present American fighter and radar screens would be unable to prevent a devastating simultaneous "Pearl Harbour" attack on dozens of American cities. A few years hence bombers would operate at speeds of 600 m.p.h. and reach altitudes of attack between 35,000 and 50,000 feet. There was no such thing as an air-tight radar defence, and no nation possessed an all-weather night-fighter capable of intercepting a modern bomber at a sufficient distance to ensure engaging it before it got to the target.

The people in charge at last seem to be about to take a few decisions. On July 8th President Truman signed a decree authorising the US Defence Department to make use of the powers of conscription which it enjoys in an emergency. The present total of 1,370,000 officers and men in the US armed forces will be increased to 2,005,000, the maximum allowed by present legislation. The share of the USAF will amount to 502,000 men, an increase of 152,000 over the present 350,000 men.

At the same time, the US House of Representatives and the Senate approved the much-disputed Compromise Bill authorising an increase in the establishment of the US Air Force, from 48 to 70 Groups. The Bill was signed by President Truman on July 12th. This increase in establishment remains purely on paper for the time being and theoretically raises the first-line and reserve aircraft strength of the USAF tp 24,000. The necessary appropriations will still have to be voted by Congress, but this seems to be easier at present than it was a short while ago. Mr. Truman informed Congress on July 19th that he was demanding a special appropriation of $10,000,000,000 for defence purposes, and at the same time he demanded a repeal of the legal top-limit of the peacetime establishment of the US armed forces.

F. T. Hearle, for many years a member of the Board of The de Havilland Aircraft Corp. and Chairman of Hearle Whitley Engineering Co., has been elected Chairman of de Havillands.

*

W. Stuart Symington, until recently Secretary of the US Air Force, and now *Chairman of the National Security Resources Board*, has prepared emergency legislation for the establishment of war controls over US economic life. These controls would provide for sweeping measures for the supervision of production, man-power, exports, prices and rationing in an emergency. On June 27th, the former Air Force Secretary strongly emphasized the necessity of thoroughly organized peacetime civil defences. The US Army has decided to assign its anti-aircraft units in the US to the US Air Force when and if needed and as soon as the Air Force requests the transfer. And General Hoyt S. Vandenberg, Chief of Staff of the USAF, announced immediately upon his return from and inspection tour of the Far East that an Air Defence Planning Board consisting of four USAF representatives and four representatives from the Civil Aeronautics Administration would be created shortly. Among other things, the Board will draw up plans for aircraft identification, develop communications between air defence control centres and interceptor stations, and provide for use of CAA facilities and employees if a national emergency arises. At a joint press conference held in Washington July 17th by the US Army, Navy and Air Force Secretaries, plans for a joint defence committee representing the US air, ground and naval forces were disclosed. Task of the new body will be to assist Defence Secretary Johnson im meeting increased commitments with regard to the military aid programme and to speed up the flow of arms to Western Europe.

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The British Commonwealth is not lagging behind the United States, either as regards criticism of the country's own preparedness or it s resolution to make good the deficiencies. Criticisms emanate not only from the politicians (the Conservative Opposition has long insisted on a secret session to obtain accurate information on the present state of the country's defences) but also from the technical experts. The Air Correspondent of the "Daily Telegraph," Air Commodore L. Payne, whose authority in problems of air strategy is undisputed, found fault especially with the alleged failure of Britain's counter-espionage activities, whereas Air Marshal Sir Guy Garrod, Chief of the RAF Mission in Washington, told press representatives that RAF Coastal Command today was a mere shadow of its former self. Most of the aircraft in service were obsolete, technical personnel and mechanics were lacking, capable officers were leaving the Service because they were underpaid. In its present state the RAF would be incapable of coping with another submarine war. The present programme to increase the RAF's fighter strength would not show concrete results before the end of 1951. Apart from that, no crews were available for the aircraft on order anyway.

*

It should be underlined, however, that there is no question of the air forces of the British Commonwealth being inactive. In July the British started a training programme which not only provides for the training of 200 selected RAF officer candidates a year but, in close cooperation with the flying clubs, provides for the adoption of a scholarship system for student pilots. A total of 1,850 college students will attend a summer camp at the RAF College at Cranwell or at Hullavington RAF Station.

The Royal Canadian Air Force proposes to start a programme at the beginning of 1951 for the despatch of fighter squadrons for training purposes to the Atlantic Pact countries. Defence Minister Brooke Claxton declared at the end of June that this scheme would in time become an important part of the Canadian defence programme.

Australia's Acting Prime Minister Arthur Fadden announced on July 14th that 13,500 eighteen-year-olds would shortly be conscripted for a six-month national military training course and that in the next four years the call-ups will affect 13,500 men in the first, 15,500 in the second, 19,000 in the third and 21,000 in the fourth year. The re-introduction of Women's auxiliary services was in preparation.

On July 11th the New Zealand Government formed a Defence Committee whose membership comprises the Prime Minister, the Defence Minister and the Minister of Foreign Affairs. This Committee, whose sessions will be attended by the Chiefs of Staff of the three Services, will coordinate New Zealand's defence measures with those of the other Commonwealth nations.

*

These methodical long-term preparations are supplemented by emergency measures to increase the first-line strength in the most threatened areas of the Western nations. In the middle of July the 45,000-ton aircraft carrier "Midway" of the US Navy left its home port of Norfolk, Va. Accompanied by four destroyers it sailed for the Mediterranean, where it took part in joint manoeuvres by the US Sixth Fleet and the British Mediterranean Fleet at the beginning of August. These exercises, in which the American aircraft-carrier "Leyte" and four cruisers as well as the British aircraft-carrier "Glory" and other ships of the Royal Navy took part, served to test the defences and the measures to keep open the Allies' communications in the Mediterranean area. The manoeuvre programme provide for airborne attacks on Malta as well as an "invasion attempt" by naval forces.

At the same time, West Pact air manoeuvres are taking place over France, Holland and Belgium. These manoeuvres, called "Exercise Cupola," are to test the air defences of the French, Dutch and Belgian industrial centres. The two preceding joint air manoeuvres, "Exercise Foil" and "Exercise Bulldog," were held over the South of England in June and in September, 1949.

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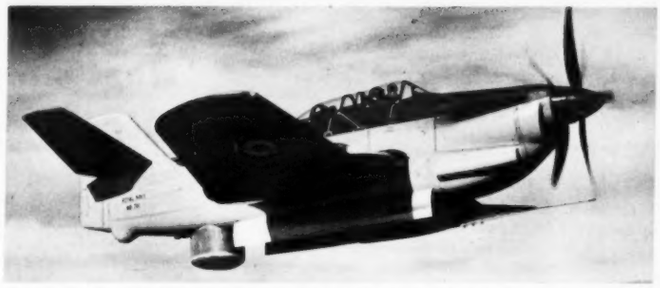
* Based on reports published in "INTERAVIA AIR LETTER," daily international aviation news digest appearing in English and French.

Two well-known personalities of American aviation politics, both partners of William A. M. Burden & Co., have joined the Board of Directors of Reaction Motors Inc. which is engaged in the development of rocket power plants : William A. M. Burden, former Assistant-Secretary of the US Commerce Department for Air and member of the National Advisory Committee for Aeronautics (right), and Garrison Norton, former Assistant-Secretary of the State Department and former chairman of the US Delegations to several ICAO conferences.

The Nord 2800 touring and training aircraft has a span of 39 ft. 4½ in. and a length of 28 ft. 4½ in. Top speed at sea level is 165 m.p.h.

The Prestwick "Pioneer 2" will probably go into quantity production at the end of this year.



The Blackburn and General Aircraft Y.A.5 with open bomb-bay and extended radome.

To strengthen the USAF's Third Air Division in England, No. 93 and No. 77 Bomb Groups (Boeing B-50 "Superfortresses") and No. 20 Fighter Bomber Group (Republic F-84 "Thunderjets") will be transferred to the RAF bases at Marham (Norfolk), Mildenhall (Suffolk) and Manston (Kent). Later on, American air force units will be stationed also at Brize Norton, Upper Hayford and Fairford.

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As was to be expected, the events in the Far East have had direct repercussions on the commercial air services and on the aircraft industry of the United States. In order to ferry air force personnel to Japan and Korea, the USAF has signed charter contracts with several American scheduled and non-scheduled air carriers : PAA, Northwest, United, Transocean, Seaboard & Western, Flying Tigers and National. A USAF spokesman made the reassuring declaration that it was not intended to commandeer US commercial transport aircraft and that no ill-effect would be suffered by the commercial air services.

On the other hand, the USAF has had to resort to its "mothball" air fleet left over from World War II. North American F-51 "Mustang" fighters and Boeing B-29 "Superfortress" bombers will be overhauled by the Grand Central Aircraft Corp., of Glendale, Calif., and by Pacific Airmotive Corp., of Burbank, Calif. Fletcher Aviation Corp. of Pasadena, Calif., has received a contract for the manufacture of jettisonable auxiliary fuel tanks, the repair shops of Slick Airways at Burbank has been awarded orders for modifications to the C-46 "Commando," standard twin-engined transport which operated "over the Hump" during World War II.

The most important event in American air transportation in the past months no doubt is the official approval of the PAA-AOA merger, which is fully dealt with on another page of this issue.

SPORTING FLYING

Reports on service aviation, which in the last issue were omitted owing to lack of space, are now out in front as a result of recent events. But, in order to provide this survey of last month's news with a more peaceful note, mention might be made of the result of the International Sailplane Championships at Orebro, Sweden. The contest ended on July 16th with the victory of the Swede Billy Nillson who attained 867.5 points. He was followed by the American P. McCready with 847.8 points and the Yugoslav M. Borisek with 777.5 points.

NEW AIRCRAFT

A month ago we spoke about new developments of several well-known American transport aircraft (Lockheed L-1049 "Constellation," Douglas DC-6 B). This time we shall report on lighter-weight models.

France's *SNCA du Nord* has announced a new two- to three-seater touring and training aircraft, the *Nord 2800,* which probably will have made its first flights by the time these lines appear. The Nord 2800 is a private venture of the concern, both from the design and financial points of view. The aircraft is an all-metal low-wing monoplane with single rudder-unit and electrically retractable tail-wing landing-gear (mechanical retraction is provided for emergencies). For the time being the aircraft is powered with a 240-h.p. Argus engine driving a two-blade c.p. airscrew. Production models would have a Potez 6 D 00 six-cylinder in-line engine also developing 240-h.p. for take-off.

Details have also been published of a light-weight of British origin, the *Auster "Aiglet."* True to the tradition of the classical "Auster line," the type differs little from the earlier "Autocrat" of *Auster Aircraft Ltd.* Principal dimensions of both types are identical. The "Aiglet" has a more powerful engine (130-h.p. "Gipsy Major 1" compared with the 100-h.p. "Cirrus Minor 3" of the "Autocrat") and accordingly has a somewhat higher performance : with a gross weight of 2,000 lbs. it has a maximum speed of 126 m.p.h. and a cruising speed of 105 m.p.h. Rate of climb at sea level amounts to 710 ft./min. The normal fuel capacity of 15 Imp. gals. gives it a range of 245 miles, but this distance can be nearly doubled by means of a 14-Imp. gal. auxiliary tank which raises the range to 465 miles.

FLIGHT TESTS

The summer heat certainly has caused you to dream of a holiday at the seashore or near a cool lake in the mountains. Why not make the trip in a "family amphibian" ? *Colonial Aircraft Corp.,* an American concern, has developed a type called "Skimmer XC-1" which seems to be eminently suitable for the purpose. However, the "Skimmer" still has to complete its C.A.A. approved type tests, but these tests should be concluded before the end of the summer. Thus you may still be able to go on your seaside holiday aboard an amphibian. The "Skimmer" is an attractive two- to three-seater shoulder-wing monoplane with a single-step hull, retractable nose-wheel landing-gear and lateral auxiliary floats. Its 115-h.p. Lycoming 0-235-C1 engine drives an Aeromatic two-blade c.p. pusher air-screw.

The *"Prestwick Pioneer 2"* of *Scottish Aviation Ltd.* is also undergoing test for its A.T.C. Like the Auster "Aiglet" just mentioned, the aircraft is a more powerful development of an earlier model (530-h.p. Alvis "Leonides" engine, compared with the 250-h.p. de Havilland "Gipsy Queen" of the predecessor type, the "Prestwick Pioneer 1"). — The "Prestwick Pioneer 2" is characterised particularly by its excellent behaviour at slow speeds, which is a product of the careful wing design (uniform chord ; NACA 4415 Aerofoil) and the use of suitable lift-increasing flaps. The latter comprise hydraulically operated leading-edge slats over the entire span ; Fowler and slotted landing-flaps extend over 57.5 per cent of the span.

CARRIER-BORNE PROPELLER TURBINE AIRCRAFT

In the course of the past few weeks, the Royal Navy carried out an experimental series of night landings and take-offs on and from aircraft-carriers with jet aircraft. The results of these tests apparently were satisfactory, for it is now reported that the first naval air squadron is to be equipped with Vickers-Supermarine "Attacker" jet fighters. In addition to the de Havilland "Sea Vampire" and the "Attacker," the Hawker „Sea Hawk" jet fighter is also in quantity production for the Royal Navy.

This triumvirate of jet-propelled fighters has now been supplemented by three propeller-turbine aeroplanes. They are the *Westland "Wyvern,"* a naval strike aircraft powered with an Armstrong-Siddeley „Python," the *Fairey 17* and the *Blackburn & General Aircraft's Y.A.5,* both of which are intended for anti-submarine warfare. The Fairey 17 and the Blackburn Y.A.5 were developed to identical specifications and therefore are very similar. Both are mid-wing monoplanes with pronounced inverted gull-wings, single rudder-unit and retractable nose-wheel landing-gear. The spacious bomb-bay of both types seems to be suitable for the carriage not only of bombs but also of torpedoes. Radar equipment is housed in a radome mounted underneath the fuselage aft of the bomb-bay. Both the Fairey 17 and the Blackburn Y.A. 5 have an Armstrong-Siddeley "Double Mamba" twin-propeller turbine engine of about 2,950 shaft horsepower. Whereas the Fairey machine has already been fitted with this engine type, the Blackburn Y.A. 5 prototype is still flying with a Rolls-Royce "Griffon" piston engine.

DESIGN COMPETITIONS AND AIRCRAFT PROCUREMENT

The victor of a US Army competition for a contract for 400 liaison and observation aircraft, the *Cessna 305,* has a comfortable wing-loading of 12 lbs./sq.ft. Developed from the Cessna 170 all-metal four-seater personal aircraft, it has a 215-h.p. Continental engine in place of the civilian type's 145-h.p. engine. The redesigned rear fuselage offers excellent vision also to the rear.

A decision has been announced also in another competition, namely, one organised by the US Navy for the design of a large anti-submarine helicopter. Participants in the contest were Bell, Convair, Curtiss-Wright, Hughes, Kaman, Lockheed, Martin, Piasecki and Sikorsky. A contract for three prototypes was finally awarded to Bell Aircraft Corp. The model is to carry radar equipment, depth charges, etc., and will have a gross weight of 13,000 lbs. Power is to be provided by a 2,5000-h.p. Pratt & Whitney radial engine.

Bell recently also announced an improved version of the civilian Model 47 Helicopter designated *Bell 47 D 1.* The four-wheel under-carriage of earlier versions has been replaced with two steel-tube skids. These are said to offer better take-off and landing characteristics in marshy territory. In addition, the use of the lighter steel supports made it possible to reduce the empty weight and therefore to increase the payload by about 40 lbs. The 178-h.p. Franklin engine of the new version can be exchanged for a 200-h.p. Franklin model. The more powerful unit enables the take-off weight to be increased to 2,350 lbs., including a payload of 989 lbs. With its 200-h.p. engine the Bell 47 D 1 has a maximum cruising speed of 96 m.p.h., a rate of climb of 875 ft./min. and a service ceiling of 11,300 ft.

Certain sporting features are attached to the comparative tests by means of which the USAF hopes to make its choice of a jet-propelled long-range penetration fighter to be put into quantity production. The aircraft in question must have a combat radius of 1,000 miles, which means a range of more than 2,500 miles —a pretty tall order in view of the high fuel consumption of gas turbine engines. Competitors are the prototypes of the following well-known swept-wing aircraft : McDonnell XF-88 "Voodoo," Lockheed F-90 and North American XF-93A. The F-90 is regarded as the fastest of the three types, the XF-88 has the longest range and the XF-93A could most easily be put into quantity production. A surfeit of riches . . .

"Look... Hands and Feet!"

Some Notes On Flying

By JACQUES LECARME, Chief of the S.N.C.A. du Sud-Est Flight Test Division

For generations pilots and technicians have been concerned with the control of aeroplanes and helicopters. Numerous ideas —and what ideas!—have been promulgated ; some have been carried into practice. Without entering into the details of piloting routine, we shall try to bring a little clarity into this complex of problems.

The pilot steers . . . the horizon

Pilot and aircraft together form a common whole—separated from the earth—a system of reference. How the earth lies or " moves " relative to this system of reference is perceived by means of the integration of a number of sensory impressions, through the collaboration of the visual, auditory and tactile sense organs. The eye recognizes position ; muscular sensations differentiate between accelerated and unaccelerated linear movement and angular movement. And the audito-labyrinthine system (organ of balance and auditory ossicles) react to angular acceleration and permit approximate determination of the apparently vertical.

Without external vision flight becomes uncertain, inasmuch as integration of the separate sensory data is no longer possible. It is for this reason that gyroscopic instrumentation is indispensable to (and prescribed for) non-visual flying. In visual flight it is the earth which is the " moving " system, steered by the pilot relatively to his system of reference. Or more precisely, it is the horizon, the line of demarcation between earth and atmosphere, since man has the habit of looking forwards.

Whoever attempts to consider flight movements from a terrestrial position often arrives at different conclusions to those reached by the pilot actually carrying them out. This is proved by the erroneous conception of " control reversal " in steep turns, a " boner " unfortunately still to be found in many textbooks. Even in steep curves, the pilot experiences no change in the direction of activity of his controls.

Thus it is clear that the view of the external world (direct or instrumentational) forms the basis of all control movements. The pilot watches neither control mechanisms nor his own hands and feet, no more than the bicyclist his handle-bars, in order to maintain his balance or to take curves correctly. And to the cinematics of rods and cables between controls and control surfaces the pilot pays no attention whatsoever.

In normal straight forward flight, the muscular sensations of the hands and feet must permit sufficient knowledge of flight conditions, so that the pilot is not required to regard the horizon unintermittently and can direct his gaze elsewhere as well. But man is so built that the greater the force exercised by his muscles, the less he is capable of accurately determining the position of his arms and legs from mere muscular sensations. Control forces increasing with augmenting control paths are for this reason the only means by which the proper relationship can be established. The pressureless zero position of the controls necessary to equilibrium during the intended stage of flight is obtained by trimming or other calibrational adjustment. On either side of the zero position the control forces should be easily perceptible even in the case of slight deviation, so that the pilot can clearly feel the pressureless position. At wider control paths, parabolic increase is desirable so that unusual control surface deviations will require unusual forces.

Controls

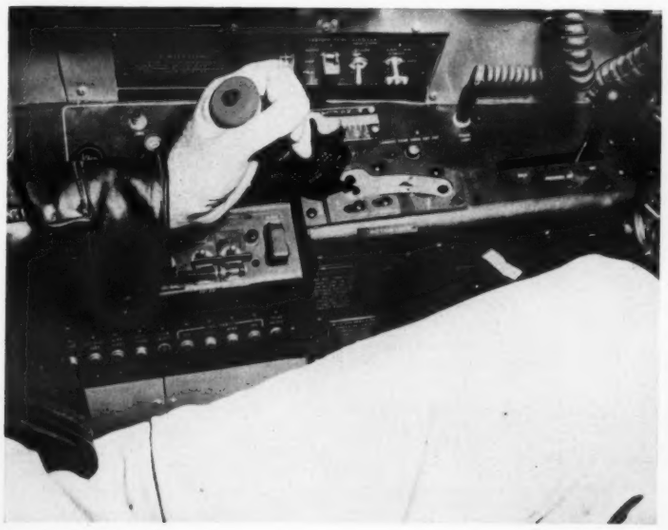
Four controls are needed for the handling of powered aircraft : elevator control, aileron control, rudder control and the power plant operating lever (throttle). However simple the manipulation of these may appear, in reality their operation is extremely complex. For these mechanisms should—at any rate in theory—permit the pilot to undertake interventions separable one from the other. Unfortunately the result of these interventions depends on the interplay of all four control variables. In point of fact, it is this which constitutes the chief difficulty of flying ! Correct approach and accurate estimation of altitude during landing is of secondary difficulty.

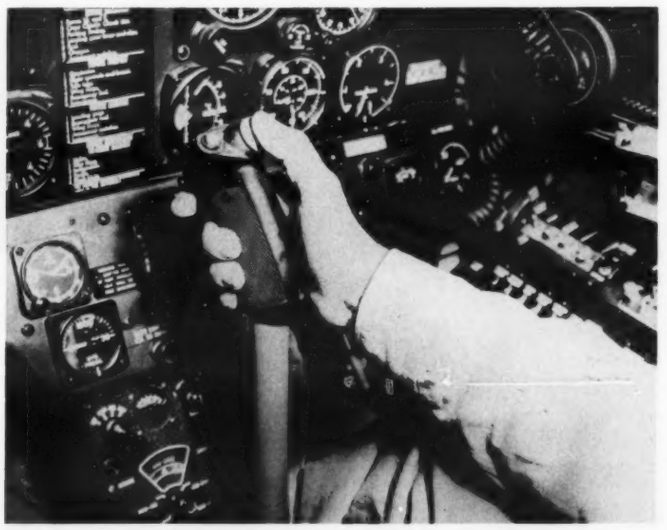
It seems to us of importance to investigate further, at any rate in their main aspects, the relationships between the manipulation of one or more controls and their effects on the aeroplane (or helicopter). In any case, careful differentiation should be made between the primary (direct) and the secondary (induced) control effects. This differentiation also permits clear recognition of defects in the flight characteristics of the aircraft. True, these defects are by no means eliminated merely by their recognition, but at any rate, one knows where one is. *Tables I and II* give an overall picture of the primary and secondary control effects.

Directions of Operation

Approximative solutions obtained step by step as well as by factual experience have finally led to directives for the manner in which the control movements should affect the response of the aircraft. Since *R. Esnault-Pelterie* a standard solution has met with general acceptance. However, it should not be thought that this is the only applicable solution. No direction of operation is in itself absolute and determined by natural laws ! Nor does there exist an instinctive feeling for it, but merely trained judgment, i.e., reflex movements acquired by practice.

This is according to the rule : The left hand on the throttle (here combined with dive-flap control), the right hand on the stick (here with thumb switch for electrical elevator and aileron trimming), both feet on the pedals. The left hand can substitute for the right. In addition, both hands are required to operate numerous switches, adjustments and navigational equipment (Lockheed TF-80 C).





Left : Wilbur Wright (in the pilot's seat) controlled banking of his first aircraft by means of a lever moved forwards and backwards. Right : since R. Esnault-Pelterie (1907), today's standard solution has gradually become established. Here it is realized on the first Curtiss " Pusher " of the US Navy (1911) : Control column (with hand wheel) and rudder-bar.

Numerous other systems of operation have at one time or another been introduced to technical practice with varying degrees of success. A few examples :

An automobile can without difficulty be driven with one hand ; it is of no consequence what particular part of the steering-wheel is held by that hand. Certain electric luggage trucks current at railway stations are steered by vertical lever movements of the right hand. And mechanical excavators can be steered quickly and precisely by a number of operating levers moved simply forwards and backwards.

In the case of a racing rowing shell, the same directional change as is obtained in a bicycle by a right-handed push on the handle-bars is reached by a push on the rudder-bar on the opposite side. Nevertheless, the mental adaptation necessary is quickly achieved. And in a sailing-boat, rudder beam and rudder wheel operate for a given turn in opposite directions.

The first Wright biplane's lateral control was obtained by means of a lever moved forwards and backwards.

Prior to 1914, the aircraft of Igor Sikorsky were equipped with rudder pedals, operating in the same manner as the handle-bars of a bicycle. This system can be tested on any two-seater sporting aircraft in which the seats are arranged side by side. Apply the right foot to the left pedal of the second pilot, and at the same time the left foot to one's own right pedal. It takes probably no longer than two minutes to find delight in this method too !

In France (and Italy) the operational directions of the throttle lever were changed. Formerly, the full-speed position lay behind and the completely throttled position forwards : to-day they are reversed (as everywhere). Nonetheless, in the transitional period, no operational error of particular consequence occurred.

Control systems with three variables

Combinational systems in which the four controls usually required are reduced to three are in many cases insufficient. Whenever simplifications of this kind are introduced, limited applicability must also be accepted. Until now it does not look as if either training or flying in general could be facilitated by this means.

Thus, for instance, considerable efforts have been made to dispense with the rudder-bar (or pedals) perhaps because of a certain inability to decide between the principle applied in rowing boats and that applied in bicycles. The results obtained have hardly paid for the efforts involved.

In the case of the " Pou du Ciel ", the ailerons were eliminated and instead the stick was connected with the rudder. The same applies to the " Helioplane " (of the American Helio Corporation in Norwood, Mass.), with the difference that about one half only of the rudder is connected to the stick, the other remaining under pedal control. Thus, both types cannot be banked and will carry out turns only by secondary effects after crabbing which, at the same time, is the best means for a fatal slide. In order to reduce this danger, the " Pou du Ciel " was given a very small wingspan (and aspect ratio), and as a consequence needed relatively high engine power even for level flight. For the same reason, the " Helioplane " is fitted with a Handley Page slot running the whole length of the span.

The " Helioplane " possesses no ailerons. About one-half of the rudder is operated from the stick, the remainder from the pedals.

Other inventors wish to eliminate the rudder-bar (or pedals) at all costs and mount all four controls on to a single steering apparatus. All that is gained is that both hands are in constant use during flight and that no possibility exists even of blowing one's nose.

Maintenance of direction—more precisely, the task of coinciding the symmetrical plane of the aircraft with the vector of the resulting flight movement—should be clearly differentiated from all flight manœuvres in the ordinary sense of the term. The latter are executed by the stick. Hence, in the case of the well-designed aeroplane the pedals are installed to prevent crabbing only. If one disregards the special cases of asymmetrical flight : unilateral engine failure, cross-wind landing, etc., it is easily seen that the pilot manœuvres only by means of spanwise and chordwise lift alterations on the wing.

Despite the fact that it is probably possible to design aircraft which will *never* crab, it is nevertheless not wrong to provide for a special, fourth control for the prevention of crabbing. It still could happen ! And crabb-

TABLE I: CONTROL EFFECTS IN AIRCRAFT

Control procedure and mechanical effect	Primary control effect	Secondary control effect
(1) **Backwards** or forwards movement of the right (or left) hand on the stick deflects elevator **up** or down. **" Elevator Control " ***	The moment of the air forces on the horizontal tail plane about the centre of gravity **increases** or diminishes the angle of incidence. The aircraft turns about the transverse axis. **" Pitching Movement "**	As a result of the **increase in lift,** or correspondingly the decrease, the aircraft **rises** (provided reserve power is available) or then sinks.
(2) Lateral movement of the right (or left) hand on the stick (or hand wheel) deflects the two ailerons, one up, one down. If the hand is moved towards the **right,** or the wheel turned towards the right, the lift of the right wing relative to that of the left is **reduced.** **" Aileron Control " ***	The moment of the now different air forces on the wing (left and right) causes it to bank. The aircraft rotates about the longitudinal axis. **" Rolling Movement "**	As a result of the bank the wing slips in the direction of the bank and causes the correctly designed aeroplane to rotate about its vertical axis in the same direction. In this way, slip is reduced and in stationary turns amounts to zero.
(3) Forward and backward movement of both feet on the mechanically coupled rudder bar (pedals) deflects the rudder to **right** or left, according to whether the **right** or left foot is in front. **„ Rudder Control "**	The moment of the air forces on the vertical tail plane about the centre of gravity causes rotation about the vertical axis and brings about crabbing . . . . ., increasing with the degree of yaw. **" Yawing Movement "**	As a result of the crabbing the correctly designed aeroplane is subjected to a rolling movement—in the same direction as the initiated crabbing—and reduces its lateral translation. The translation disappears in the stationary curve.
(4) **Forward** and backward movement of the left (or right) hand on the throttle lever **increases** or reduces thrust (power). In the case of airscrew-engines, separate controls are often present for torque and r.p.m. adjustment. **" Engine Operation "**	The altered thrust of the airscrew or jet engine **accelerates** or slows down the aeroplane longitudinally.	Drag **increases** or correspondingly decreases, until a new equilibrium is reached. ** The aeroplane **increases** or decreases its angle of incidence and **rises** or loses altitude. The altered torque of the airscrew can bring about rolling and yawing movements.

* Elevator control and aileron control are mechanically coupled through the stick (or a control column with hand wheel).
** Equilibrium between the thrust of the airscrew (or jet), total resistance and the gravity component in or opposite to the direction of flight.

ing is one of the most frequent causes of mortality amongst pilots. Thus it can be seen that the hitherto conventional solution is by no means the worst. For the greater part of the flight, the pilot is required to use three controls only ; if he should happen to need them, all four are at his disposal. With this we arrive at the most difficult problem in flying.

Interaction

In all present aircraft it is almost completely impossible to separate the secondary effects of the ailerons and the rudder from each other. For this reason, the correct operation of the pedals and the stick simultaneously is the source of extreme difficulty to the student pilot.

If only we were able to construct an aircraft in which the ailerons effect a pure roll whilst the rudder brings about a pure yaw, i.e. simple rotation about the vertical axis of the aeroplane without induced crabbing ! I believe that this would constitute a considerable step towards simplification of flying, particularly in the case of precision landings in bad visibility.

So far as I am aware, only one designer has thought about this problem until now : the French engineer *P. E. Mercier*. Unfortunately, the aeroplane (Lioré & Olivier Lé0.48) in which this control system—after conclusion of the wind tunnel trials—was to have been tested, was a victim of World War II.

The coupling of secondary effects is also to be found in the case of the swept-back wing. In this type, roll-yaw coupling depends to a particular extent on the angle of incidence. As a result, various artifices have often to be employed—e.g. increases in the oscillation period or in damping—in order to obtain acceptable flight characteristics. In the Boeing B-47 " Stratojet ", which is fitted with a pronounced swept-back wing of very large aspect ratio and thus manifests a strongly negative dihedral effect at larger angles of incidence, even gyrometers for angular velocity had to be installed in the rudder control mechanism, permitting rudder control to become effective only after correct integration of the rolling and yawing movements and in the correct phase.

It goes without saying that everything is done to reinforce the direct (primary) effect of each individual control element and to attenuate as far as possible the induced (secondary) effect.

The time factor

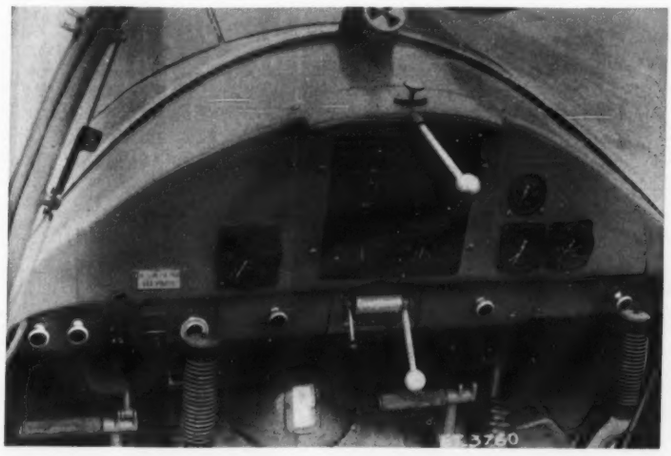
A normal human being requires two- to five-tenths of a second to appreciate a sudden lateral movement. The period required to translate appreciation into active intervention is about the same. Between the perception of an undesirable deviation and its correction there is thus a lapse of about 0.4 to 1.0 seconds. To this must be added the reaction time of the aeroplane itself, corresponding to its control efficiency and inertia moments, as well as the conditions of the airflow.

In general the following is valid : The longer the oscillation period of the aircraft, and the stronger the damping, the easier it is to fly. It is for this reason that giant aircraft are always easy to fly, though not always easy to guide—which is not the same thing.

On the contrary, small aircraft are often quite difficult to manipulate, in particular whenever they are both very small and very rapid. This applies, for instance, to the high-speed aeroplanes of Caudron from before the war and to the single-seater racing aircraft of the " Cosmic Wind " type. Their small wing span and wing area, insignificant inertia and high speed results in weak damping and short oscillation periods. The pilot is then forced to steer in a very controlled, sensitive and precise manner. Lateral movements must be " evened out " (by partial anticipation of the control effects) ; every merely reactive " defense " leads to over-control.

Finally, the pilot himself is nothing other

Conventional dual control arrangement in a personal aircraft (SNCA du Nord " Norécrin "). Apply your right foot for a change to your neighbour's left pedal and your left foot to your own right pedal !



In the case of the " Ercoupe " (of the Engineering and Research Corp.), the pedals have been eliminated ; the (dual) rudder is interconnected with the ailerons. But the aircraft cannot be side-slipped.

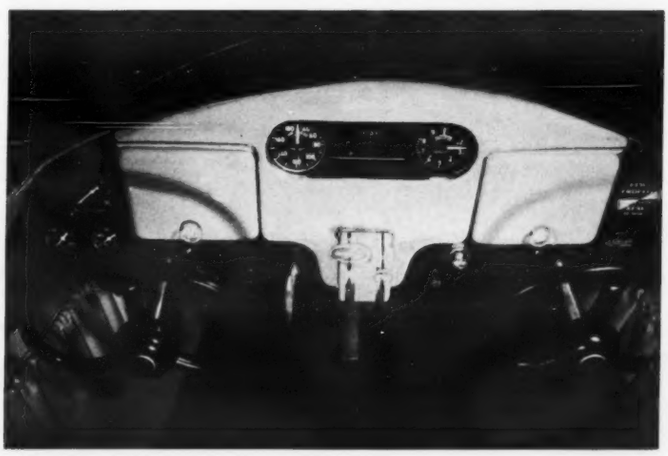


TABLE II : CONTROL EFFECTS IN THE HELICOPTER (Single-rotored type with rotor—Sikorsky, Bell, Hiller type, etc.)

Control procedure and mechanical effect	Primary control effect	Secondary control effect
(1) Forward or backward movement of the right (or left) hand on the stick tips the resultant rotor force **forwards** or backwards, as the case may be, without altering its magnitude. **" Longitudinal Control " ***	The helicopter accelerates **forwards.** (When the hand is moved backwards, there is a delay in forwards movement or the helicopter accelerates backwards.)	As a result of the forward speed and dependent on it, there is a change in the rotor force and longitudinal moment. The helicopter changes its angle of incidence and with this its speed, rotor force and flight trajectory. **
(2) Lateral movement of the right (or left) hand on the stick tips the resulting rotor force to the side without altering its magnitude. Movement of the hand to the **right** also tips the rotor force to that side. **" Lateral Control " ***	The helicopter accelerates to the **right** or left.	As a result of the lateral speed and dependent on it, there is a change in rotor force and rolling moment. The helicopter attempts to climb and tips to the **right** or left, as the case may be. The lateral air stream over the fuselage (and fin) initiates a curve to the **right,** or correspondingly the left.
(3) Forward and backward movement of both feet on the pedals alter the thrust of the tail rotor. When the **right** foot is moved forward, the auxiliary rotor pulls the fuselage tail more strongly to the **left** ; foot pressure on the left pedal causes the opposite to take place. **" Directional Control "**	The helicopter rotates about its vertical axis to the **right** or left, as the case may be.	Dependently on the flight speed, the rolling and yawing moments change : In forward flight the helicopter curves towards the **right** or left, correspondingly, and at the same time tips towards the **right** or left. In hovering flight no secondary effect occurs.
(4) Upward or downward movement of the left (or right) hand on the collective pitch lever **increases** or reduces correspondingly the rotor force by means of simultaneous increase or reduction of the rotor blade angles (main rotor, possibly the auxiliary rotor as well) **and** engine power. For the precise regulation of the latter, the handle of the lever is rotatable. **" Rotor Force "**	The helicopter **increases** or reduces its vertical rate of climb (acceleration).	As a result of the change in torque there is rotation about the vertical axis, which has to be compensated by foot pressure on the pedals of the directional control (Sikorsky and Bell types), provided there is no automatic pitch adaptation in the auxiliary rotor (as in the SE 3101 and Hiller types).

* Longitudinal and lateral controls are mechanically coupled through the stick.
** Forward movement of the stick tips the rotor axis forwards : Speed increases, the rotor force is augmented owing to the more obliquely attacking air stream, the helicopter attempts to climb obliquely forward.

than a sort of servo-mechanism. On the path between sensory impressions and muscular movement there is a phase-shift depending on the entire personality, which for its part can lead to instability in certain cases. For this reason I should like to aver that the psychotechnic adaptability test, especially the Nyquist Diagram, offers an important basis for the selection of pilots for particular tasks.

Here are two examples : In flight-testing the De Havilland " Vampire " and Gloster " Meteor " jet-propelled fighters, it was observed that the period of yawing oscillations was shorter than that calculated, whilst, on the other hand, yaw damping was less than estimated. Thus, the pilot had a difficult time of it. Owing to the unavoidable delay in his muscular movements relative to his sensory impressions, control intervention occurred with such a phase-shift that the yawing oscillations were uncoercible. — In order to alleviate this, the fins were *reduced* in area and thus directional stability deteriorated, with the result that the oscillation period became greater and damping remained approximately the same. It was only then that both types flew better —even though (or rather because) they were less directionally stable. For the same reason, the Messerschmidt Me 262 had to be fitted out with an automatic directional pilot.

Furthermore, the pilot must be capable of sufficient calm and control not to react to transitional roll impulses. Should he attempt to compensate for these, the inevitable delay in reaction would simply augment the error.

Helicopters

For single-rotor helicopters with tail rotor, the relationships are tabulated in *Table II*, using the Sikorsky S. 51 as an example. In the case of other fundamental types, the control system is, it is true, more complicated, but nevertheless may be analysed in similar fashion : *Piasecki System :* By means of fore and rear movement of the control stick, the direction of the rotor forces on the fore and rear rotor (through the cyclic pitch control) is varied *in parallel* and at the same time the magnitude of the force of each rotor is accordingly augmented and reduced (through the collective pitch control). When the stick is moved forward, the helicopter moves *and* inclines forwards, i.e. the secondary effect is correctly built into the system in this case.

Focke System : In this case, lateral movement of the control stick simply changes the left of the two laterally arranged rotors in magnitude. As may be immediately recognized, this system has its faults. The pilot only initiates a rolling movement. It would be better if this were to be induced by a lateral movement. So the helicopter can only fly sideways when it tips laterally beforehand. This contains inherent disadvantages —e.g. different reactions of the ground against both rotors—and renders control considerably more difficult. This also makes it practically impossible to eliminate the variable influence of a side-wind.

Landgraf System : With identical lateral rotor arrangement, the disadvantage mentioned in the preceding case has been eliminated. The pilot controls the rotors in the same way as in the Piasecki system. The resulting rotor forces are thus shunted parallel to each other (for lateral movement) and at the same time altered in their magnitude (for banking).

Sud-Est System : In the case of the S.E. 3101, the angle of incidence of the main rotor — and with it the direction of the rotor force—was initially controlled by global lift alterations in the two auxiliary rotors mounted on the fuselage tail. The disadvantages of this system are obvious : The horizontal component of the rotor force is coupled with the angle of incidence of the longitudinal axis ; a quick stop during flight leads to exaggerated rearing up ; the pitching movement has a much longer period than the rolling movement, etc. Hence, this control system was again abandoned and a longitudinal control system by means of cyclic pitch control was introduced (in the S.E. 3110). The lift alterations in the auxiliary rotors now serve only for trimming purposes (incidence and torque).

The Sikorsky S-51 four-seater helicopter and its controls : Every deviation of the stick alters the cyclic pitch control of the main rotor and tips the resulting rotor force in the direction of deflection; both pedals control the blade angle of the tail rotor. To the left (and below) is the lever for the collective pitch control of the main rotor blades (with a rotatable handle for power adjustment).

Piasecki HUP-1 : Forward and backward movement of the stick simultaneously alters the direction and magnitude of the fore and rear rotor force.

Focke Fw 61 : Lateral movement of the stick merely alters the magnitude of the rotor force to the left and right.

TABLE III : DISTRIBUTION OF CONTROL FUNCTIONS

Extremity used	Aircraft	Helicopter
Right hand	Controls the angle of incidence of the aircraft's longitudinal axis and rotation about this axis. **Control of the first order ;** (longitudinal movement) or in accordance with angular speed (rolling movement).	Controls the direction of rotor force and consequently the magnitude of its horizontal component. **Control of the second order.**
Left and right foot	Controls the direction of the aircraft's longitudinal axis. **Control of the first order** in accordance with angular velocity (yawing moment).	Controls the direction of fuselage axis. **Control of the first order** in accordance with angular velocity.
Left hand	Controls the magnitude of airscrew (or jet) thrust. **Control of the second order.**	Controls the magnitude of rotor force. **Control of the second order.**

Comparison of the conventional control systems

In *Table III* the conventional distribution of control functions to hands and feet in the case of the aeroplane and the helicopter is set out for purposes of comparison. The induced secondary effects are not taken into account.

The concept " control of the first order " comprises the direct connection between the position of hand or foot and the values of the variables depending on them. Each stick position (in the plane of symmetry) corresponds, for example, to a specific speed of equilibrium (angle of incidence)—provided all other conditions remain the same.

The meaning of the term " control of the second order " can be shown by the following example : Let us regard a helicopter hovering about one meter above the earth's surface. The helicopter is in a state of equilibrium, i.e. all control variables are adjusted to this condition. If now the pilot wishes to rise vertically to a height of two meters, he must increase the lift of the rotor to some extent. The helicopter begins to rise vertically with uniform acceleration—at any rate in principle, inasmuch as the effect of air resistance complicates the procedure to a certain extent. Upon reaching a height of 1.50 m, the pilot must already start to think about gradually reducing the rotor lift in order to reduce the vertical speed and thus arrive at the desired height with zero speed. Otherwise he would have to throttle down—at 2 m altitude—the rotor lift temporarily to a value below that needed for hovering so that the helicopter should not rise higher than desired—and afterwards again readjust. Thus it can be seen that this complicated manœuvre places considerable requirements on the pilot's capacity, and that chief of all, everything depends on his ability to size up the nature of the procedure. As a consequence, every greenhorn helicopter pilot succeeds in executing a number of highly entertaining aerial jumps.

Landgraf H-2 : Lateral movement of the control column simultaneously alters the direction and magnitude of the rotor force to the left and right.

Sud-Est SE 3110; Control of the rotor force direction by means of cyclic pitch control; the change in thrust of the auxiliary rotors serves merely for compensation of torque and for trimming.

Concluding Remarks

Universal judgments, such as those to the effect that a certain type is " difficult to fly " or " very sensitive " are of no value. Nor is the requirement, " the pilot simply has to know how " helpful at all. There are no tricks and no " directions for use ". But one thing frequently does happen : the inferior adaptability of the aircraft to the human being. This can arise from incomplete separation of the control effects, or from the fact that the aircraft's response is badly adapted to the pilot's reaction time. The explanations held in readiness in pilot training schools for this tendency often tend towards the mystical. In reality, the difficulties are highly prosaic in nature.

The remarks on the separation of control variables apply to an even greater extent to instrument flight and bad-weather landings. In many cases clarity in this connection can be obtained when comparisons are made between pilot training times for different aircraft types necessary for the expert execution of two different procedures : altering the QDM course in instrument flight and accurate instrument landing with the use of the ILS cross-pointer.

The better one knows what one is doing, the quicker one will also learn to do it better. A pilot who knows how to think will soon become expert with any new type. " Retraining " becomes necessary only by virtue of the aeroplane's inherent faults. And the often recommended and even officially prescribed " specialisation " on certain types is basically nothing but the adaptation of the pilot to the aircraft's weaknesses. Is it then capable of improving the working conditions of the pilot ?

To repeat : The entire difficulty of flying lies in the mutual relationship between all control effects. As soon as individual control elements can be isolated to the extent that they alter a particular variable only and do so " of the first order ", these difficulties are immediately reduced. Response is better ; a periodic oscillation and critical damping are approached.

How much better it would be, therefore, to attack and solve these problems, than merely to subject them to a meticulous classification ! Unfortunately, however, men able to recognize and eliminate faults in aircraft design are few, at any rate fewer than those who prefer to let their behaviour be dictated by these same faults.

Swept-Forward Wings

By *Flugkapitän* SIEGFRIED HOLZBAUR, Stuttgart

To-day it is possible to propel jet-powered airframes at velocities within the critical range of the speed of sound without incurring dangerous disturbances. In the near future power plants capable of accelerating such aircraft to speeds of several thousand kilometres per hour will probably become available. Essentially greater, however, is the problem of safely landing an ultrasonic aircraft, equipped as it is with either a very small wing or none at all. An uncontrolled landing by means of a parachute can be taken into consideration in special cases only; a sufficiently large wing continues to be indispensable in the majority of cases.

The wing, an impediment to high speed but a necessity for low-speed flight, must be designed so that it is little affected by the disagreeable and dangerous disturbances set up in the sonic range, yet at the same time suffices for take-off and landing requirements. The flight tests carried out with the jet-propelled *Junkers Ju 287* powered with four (later six) Junkers 004B engines (each with a static thrust of 900 kg. = 1.980 lb.), the wing of which had a very pronounced sweep forward, offered an interesting contribution to this problem. Designed in 1942-43, the Ju 287 in the summer of 1944 underwent its flight tests as the world's first jet-propelled bomber (fig. 1).

Following is an account of certain—hitherto unpublished—aerodynamic aspects and flying characteristics of this type.

It was well known that a swept-back wing reaches higher critical Mach numbers than a straight wing, i.e., that it permits greater speeds under otherwise identical conditions. From this it was concluded that a swept-forward wing should show similar favourable results. In addition, it could be presumed that the " negative arrow shape " of the wing plan would manifest interference advantages both at subsonic and supersonic speeds, inasmuch as all disturbances and compression shocks originating from the wing-root cannot reach the wing tips, travelling ahead of the roots.

Numerous wind tunnel trials and calculations confirmed the basic behaviour of this arrangement. It was shown that a negative wing sweep angle of approximately 25° resulted in a considerable increase in the critical Mach number—up to values of Mach 0.80 or even Mach 0.85. Moreover, it seemed certain that the wing would be able to be subjected to very high angles of incidence and would yield relatively high lift coefficients.

Inasmuch as the tips of such a wing are continuously traversing undisturbed air, the lift-decreasing and resistance-increasing wash-out can be omitted—unlike the swept-back wing, where the boundary layer becomes turbulent at high angles of incidence, from the wing-roots towards the tips, and thus increases the tendency of the wing to drop and decreases aileron control.

For the same reason the ailerons on the swept-forward wing can be " drooped " as a supplementary landing aid without deterioration of manœuverability and stalling characteristics.

Hence, the swept-forward wing seemed to offer the same advantages as the swept-back wing in high-speed flight (increase in the critical Mach number) and at the same time promised—at least according to the wind tunnel data—much better slow-flying characteristics. Were it possible to construct an *infinitely rigid* swept-forward wing, this second advantage would be decisive. However, the negatively swept wing—like every other type—tends to bend in pull-outs, gusts and turns which, as a result of the wings' geometric relations, leads to increasing angles of incidence in the direction of the wing-tips. This goes hand in hand with a movement to outboard of the lift and a deterioration of longitudinal stability. With increasing speed, the stability losses become more and more critical and can even lead to instability. As a consequence, swept-forward wings must be constructed in a particularly rigid manner, which in the case of thin high-speed airfoil sections cannot be attained without considerable weight penalty.

Lateral stability determinations in the wind tunnel showed a further disagreeable characteristic of this wing shape: an increase in the rolling moment due to crabbing with increasing speed. Exactly the opposite would be preferable. Increasing rolling moments during high-speed flight exaggerate the aircraft's sensitivity and can precipitate lateral oscillations, whilst in low-speed flight they even relieve the pilot to a certain extent. In this connection, the swept-back wing proves to be more advantageous.

In contradistinction to the swept-back wing, the swept-forward type possesses no directional stability whatsoever and can therefore not be operated as a " flying wing ". In the case of an aircraft equipped with fuselage and tail-unit, this inadequacy is of no particular importance, inasmuch as the stabilizing effect of a correspondingly large-dimensioned fin and rudder is great enough by far to overcome the negative yawing tendency due to crabbing of the swept-forward wing and thus guarantees a sufficient directional stability.

So far as the flight characteristics of the Ju 287 could be pre-determined by wind tunnel tests and aerodynamical calculations, this was already done during the designing stage of the type. For the first prototype (Ju 287 VI) the component parts of other well-tried aircraft were utilized as far as possible in order to reduce the element of risk. Thus, the fuselage was taken over from the Heinkel He 177, the tail-unit from the Junkers Ju 188, and the landing-gear, as a matter of fact, from a Convair B-24. Hence, only the swept-forward wing corresponded to the original design. This procedure proved to be a very happy solution and made it possible to carry out the flight trials in a very short time and without excessive difficulties. Smaller breakdowns, such as failing power-units, exploding take-off rockets, etc. did, nevertheless, occur.

The maiden flight and a further series of 16 trial flights lasting up to 40 minutes took place at the Brandis aerodrome near Leipzig (figs. 2 and 3). They were the cause of lively discussions on the part of the aerodrome personnel and the inhabitants of the surrounding region. Since at that time no one as yet had seen so large and unconventional an aircraft powered solely with jet engines, the spluttering and hissing monster, aided at take-off by an additional set of four large rockets, was probably regarded by many as an ultra-modern " wonder-weapon ". That even then serial production could hardly be envisaged was recognized only by the few.

In general, the flight characteristic measurements agreed very well with the wind tunnel investigations and calculations. Manœuverability and stability around the

Fig. 2: A Ju 287 VI taking off at Brandis aerodrome near Leipzig. Four axial-flow turbo-jets Junkers 004 B (each producing 900 kg static thrust) and four Walter take-off rockets (each developing 1000 kg thrust during 40 seconds) get the monster off the ground.

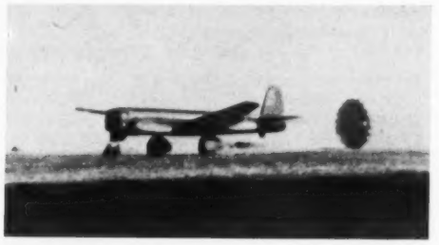


Fig. 3: And here the prototype landing: After touch-down, a breaking parachute is released from the fuselage tail and shortens the landing distance. Landing speed is approximately 190 km/h; approach speed 240 km/h.

Fig. 1: In this prototype (VI), of the Ju 287 jet bomber, the only original element was the striking swept-forward wing. The fuselage was taken over from the He 177, the tail-unit from the Ju 188 and the provisional non-retractable undercarriage even from a Convair B-24. The powder rockets beneath the jets served as take-off aids; after firing, they were jettisoned and landed with parachutes.

MEASUREMENTS, WEIGHTS AND PERFORMANCE
Ju 287 V 1 Prototype

(Powered with four Jumo 004B axial-flow turbo-jets and four 1000-kg Walter take-off rockets)

Wing span	20.1 m
Length	18.3 m
Wing surface	58.3 m²
Take-off weight approx.	20.0 tonnes
Empty weight »	12.5 tonnes
Take-off thrust »	7.6 tonnes
Maximum speed	650 km/h

Ju 287 V 3 « O »-series version

(Powered with six BMW 003 turbo-jets and take-off rockets)

Wing span	20.1 m
Length	18.6 m
Wing area ·	58.3 m²
Take-off weight approx.	21.5 tonnes
Calculated max. speed	865 km/h
Calculated range	1890 km
With bomb load of	3000 kgs

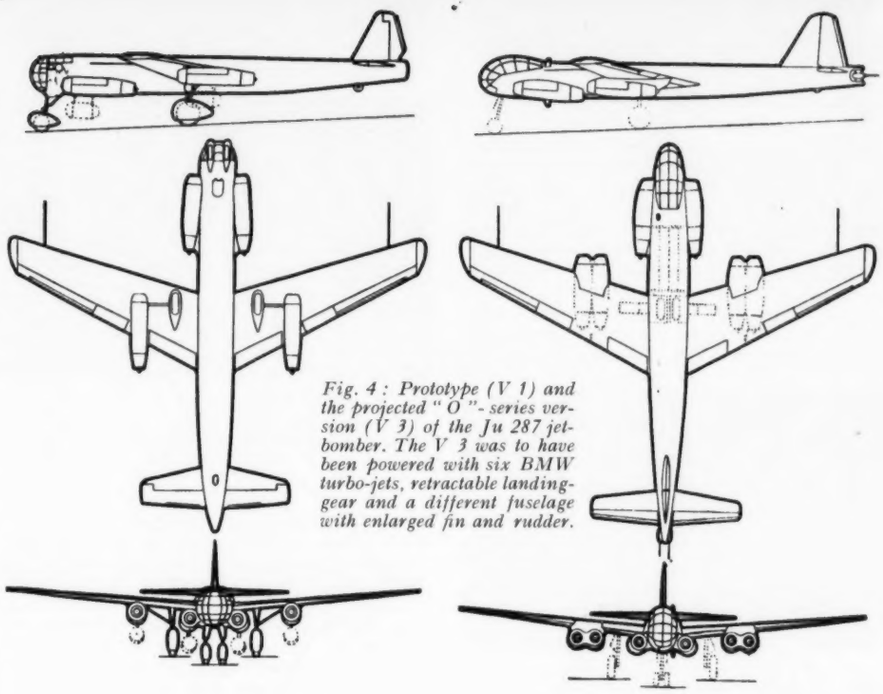
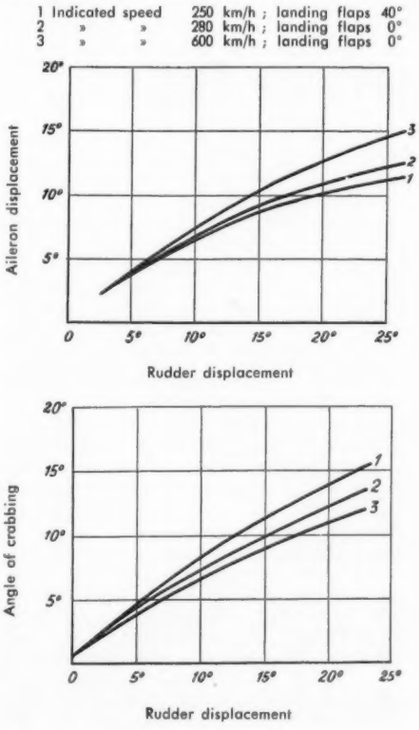


Fig. 4 : Prototype (V 1) and the projected " O "- series version (V 3) of the Ju 287 jet-bomber. The V 3 was to have been powered with six BMW turbo-jets, retractable landing-gear and a different fuselage with enlarged fin and rudder.

lateral, longitudinal and vertical axes were determined at centre of gravity positions between 5% MAC (mean aerodynamic chord) in front of and 8% MAC behind the wing-root leading edge and at all landing-flap positions. They were very satisfactory. The balance changes during retraction and extension of the landing-flaps remained smaller than expected and were controllable without compensatory trimming. Landings (with approximately 300 kg/m² wing loading) could be accomplished with the still well controllable approach speed of 240 km/h and with touch-down speeds of 190 km/h, corresponding to lift coefficients of 1.0 for approach and 1.7 for touch-down. The relation between both values and the relatively high maximum lift coefficient are very favourable when compared with other aircraft. As the landing-gear of the prototype was not retractable, the maximum speed had to be limited to 650 km/h for the flight trials.

In the longitudinal motion from trimmed straight flight equilibrium, the prototype showed the usual picture for aircraft of this size concerning elevator stick forces as a function of dynamic pressure changes, as well as faultless static stability throughout the whole speed range and without symptoms of discontinuity. A more exact investigation of the dynamic longitudinal stability was not carried out, since the high resistance of the fixed landing-gear would have falsified the results to too great an extent. During turns and pull-outs from dives firsts symptoms were manifested of a bending of the wing leading to increased angles of incidence. This appeared from the fact that the elevator stick forces (and control paths) under these conditions were smaller than those which would have corresponded—at equal dynamic pressure and angle of incidence—to the calculated rigid condition. Hence a tendency to longitudinal instability, as has been mentioned earlier, must have already been present. In addition, the masses of the outboard power units, fixedv ery far back on to the wing, likewise increased the angle of incidence. For this reason, it was planned to mount the jet nacelles at the wing leading edge in the case of the projected " O "-series version (Ju 287 V 3), a method which simultaneously offers vibration advantages (fig. 4).

Fig. 5 : Aileron displacements (above) and angles of crabbing (below) in relation to rudder displacement at various flight speeds and crabbing-rolling equilibrium.

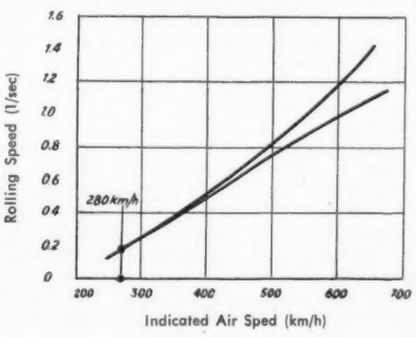

1 Indicated speed 250 km/h ; landing flaps 40°
2 » » 280 km/h ; landing flaps 0°
3 » » 600 km/h ; landing flaps 0°
Aileron displacement
Rudder displacement
Angle of crabbing
Rudder displacement

Researches into the at first very much doubted field of lateral stability called for a great deal of attention and care. First of all, the crabbing angles appearing during stationary crabbing at various speeds and landing-flap positions, as well as the aileron deflections necessary for the equilibrium, both as a function of the rudder deflection, were determined (fig. 5). This was undertaken in order to obtain values for the static directional stability and for the rolling moments due to crabbing. It became apparent that these rolling moments increased, it is true, with augmenting flight speed, but nevertheless not so pronounced as expected. They were not in any way disagreeable with flight trial speeds up to 650 km/h. Yawing oscillations caused by sudden rudder displacement disappeared very quickly.

A further method for the determination of lateral stability was the following : In forward flight, the angular speed rolling depends on aileron displacement and on flight speed ; during crabbing with a constant crab angle it depends on the magnitude of the rolling moment due to crabbing and on flight speed. Fig. 6 shows a comparison of this kind. The initial values for aileron displacement (8 degrees) and crabbing angle (9 degrees) were taken from stationary crabbing at 280 km/h indicated air speed and retained throughout the range of comparison. The illustration reveals that the angular rolling speed due to crabbing increases with augmenting velocity sharper than the rolling speed due to aileron displacement. This is another proof of the disadvantageous trend of the rolling moments due to crabbing with swept-forward wings. In this connection, it should further be mentioned that the diagrams (figs. 5 and 6) do not claim numerical agreement with the original measurements, but merely serve to explain the basic relationships.

In order to investigate the aircraft at large angles of incidence, stalling tests were carried out. The upper surface of the wing was covered with woollen yarn by means of adhesive. A cinematographic camera mounted in front of the fin and synchronised with the other measuring instruments recorded the positions of the yarn streamers during stalls and thus permitted reconstruction of the airflow over the wing. Fig. 7 shows the experimental set-up. With completely extended landing-flaps (40°) and the ailerons operating as accessory landing aids (23°) the aeroplane was stalled at high altitudes. The

Fig. 6 : Comparison of the angular rolling speed resulting from an 8°-aileron displacement (lower curve) with the rolling speed resulting from a 9° angle of crabbing (upper curve).



airflow began to break away at the wing root. This was initially noticeable as is usually the case, by means of disturbances in the relatively low-set elevator. Upon further pull, the airflow broke away also on the wing sections above the nacelles. Finally, the entirety of woollen streamers from the fuselage to the domains of aileron were seen to be eddying. It was only at this point that the aircraft began to head down, though it showed no tendency of dropping a wing. This very desirable quality nevertheless changed once the aircraft was stalled during crabbing, i.e. after power-plant failure on one side or following rudder displacement. Here, the following became apparent: The wing crabbing in front of the other reveals a deteriorated span chord ratio as a result of the negative sweep, whilst the other reveals a bettered ratio. The result is an increasing rolling moment with augmenting angles of incidence (and angles of crabbing), tending to press down the advancing wing. It is true that the pronounced dihedral of the wing sets up an opposing and compensatory tendency which in the case of smaller angles of incidence suffices to re-establish equilibrium. However, in the case of higher lift coefficients between 1.4 and 1.5, the resulting rolling moment due to crabbing changes its sense of rotation, so that a compensation by means of aileron displacement now becomes necessary and in turn leads to an even greater deterioration of the conditions on the wing tip travelling ahead. In consequence, break-down of the airflow, after further pull occurs at the wing tip of the advancing wing; the aircraft tips over laterally on this wing tip and, naturally, can no longer be held straight by aileron. At the same time, the loss of lift at the wing tip leads to a nose-heavy longitudinal moment, so that the aeroplane also tips over head-first and hence accelerates. Stalling tests during crabbing were repeatedly undertaken, without ever leading to a really dangerous situation. An increase of the dihedral beyond 8°, wash-out or reduction of the aileron displacement as a means of increasing lift during take-off and landing would have led, it must be admitted, to an improvement in the peculiar characteristics outlined above, while at the same time, however, bringing other disadvantages. It is essential, however, to provide, in the case of swept-forward wings, a generously dimensioned fin and rudder . . . the increased static directional stability of which prevents exaggeratedly large angles of crabbing, e.g. in the case of power-plant failure.

In conclusion, therefore, it can be said that the trials confirm the numerous advantages of the negatively swept wing, despite the many problems still to be investigated in connection with it. It was not possible to undertake researches on the first prototype (Ju 287 VI) at high subsonic speeds. With this aim in view, a second prototype (Ju 287 V 2) and the " O "-series version (Ju 287 V 3) were projected, whose construction had to be discontinued owing to the events of war. Presumably, trials have been carried out elsewhere. Recent press reports point towards this possibility. It might be interesting to ascertain whether this form of wing has or has not proved its value at high and highest speeds. However, it is obvious that an easy way out of the cul-de-sac in which high-speed flight now finds itself has yet to be discovered.

Fig. 7: Experimental set-up for stalling trials: The wing upper surface is laid out with glued-on woollen streamers, which no longer lie in the direction of flight during break-away of air flow. An automatic cinematographic camera mounted just in front of the dorsal fin records their positions during progressive stalling.

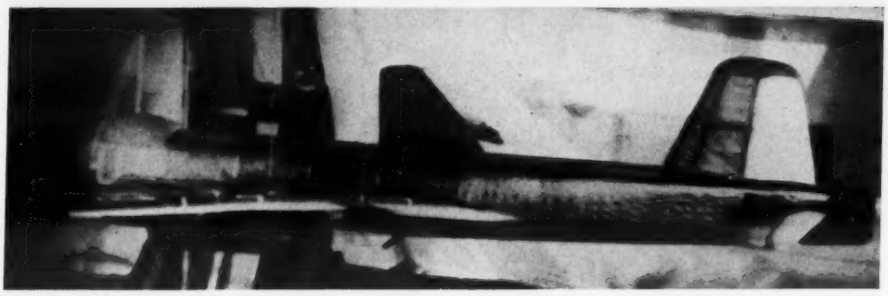


Fig. 8: Is the Ju 287 being further developed behind the Iron Curtain? This photo, taken from within the large Junkers wind tunnel, arrived in the West by a very circuitous route. The model aircraft under investigation corresponds to the Ju 287 V 3 " O "-series version illustrated in Fig. 4.

A Rocket Researcher's Reflections on Supersonic Flight

By Professor HERMANN OBERTH, Oberried, Lake Brienz, Switzerland [1]

If one considers the supersonic aircraft designs which so far have become public property, one frequently comes to the conclusion that their authors had to struggle against psychological as much as against structural difficulties. The behaviour of a body at supersonic speeds is fundamentally different from that at subsonic velocities, and no maxim which has proved itself to be correct and practicable in subsonic aircraft can simply be applied to supersonic aircraft. Furthermore, when considering each requirement tacitly demanded from the subsonic aircraft, one should ask oneself the question whether it really is an indispensable prerequisite. It will be found that it is possible to disregard many things which would be difficult to realise under supersonic conditions. Conversely, certain things which practically can be ignored in subsonic flight might have a catastrophic effect at supersonic velocities, such as frictional heat produced by the airstream or compression heat, or the effect of small projections and of sharp edges on the flying characteristics.

The aircraft designer who has become accustomed to the laws of subsonic flight (for in any professional activity habit plays an important role) in some respects may find it more difficult to construct a supersonic aircraft than the rocket builder who is a little more familiar with the conditions of supersonic velocity. In addition, aircraft engineering is guided by conventional rules to a greater extent than rocket engineering. The aircraft designer is therefore accustomed to comparing his lay-out to that of aircraft already existing, whereas the rocket expert tends to evolve novel solutions for novel tasks, without being disturbed by the thought that nothing similar has ever been done before. For this reason I believe to be entitled, though I am not an expert in the field of aircraft construction, to contribute to the problems of supersonic flight.

*

Briefly, the tendency in the design of supersonic aircraft has been to build a subsonic aeroplane capable of maintaining itself *also* at supersonic speed. The right approach would be to develop an entirely novel supersonic design which below the sound barrier must merely satisfy a single requirement, namely, to be able to land in a glide and at relatively low minimum speed. In addition, it should not get out of control or break up in the transonic range. I shall attempt to explain this with the help of a few examples:

Fig. 1a shows a subsonic wing for Mach numbers up to 0.7 (which means that in this case the speed of the aircraft may not exceed 7/10th of the speed of sound). Fig. 1b illustrates a swept-back wing for Mach numbers up to 1.0. Fig. 1c shows a " delta wing " of the type which until recently was considered as the most suitable for speeds up to $M = 1.4$. More recent investigations seem

[1] See also our interview, " Hermann Oberth, Shaper of Things to Come ". INTERAVIA, Review of World Aviation, September 1949, pp. 558 to 560.

to indicate, however, that for higher Mach numbers rectangular wing plan forms with sharp leading edges would be as good if not better.

This shows that the wing unit as such has remained an axiom, and all that has been done is to study how it can best be adapted to higher speeds. The fact that even for relatively optimum plan forms the lift drag ratio deteriorates is considered as something immutable, as a result of which one merely endeavours to save what there is to be saved. No advantage has as yet been taken of the elasticity characteristics of the air, and the thickness of the wing dictated by strength considerations is regarded merely as an indispensable nuisance. If it were at all possible, wings would be made as thin as a razor blade.

The same applies to the fuselage. It is regarded from no other angle than in the case of the subsonic aircraft, and it is made as slender as possible only to overcome the high drag values. The power plant is accepted as having to consist of a jet pipe, combined with a turbine and a compressor, of sufficient power to lift the aircraft from the ground after a long run and then gradually to increase its speed to a rational cruising figure. In other words, the *subsonic jet aircraft has merely been adapted for use at supersonic speed.* Instead, the principle shown in Fig. 2 could have been applied to the wing. In this design the wing is perforated by parallel ducts which take in the air meeting the leading edge and pass it through the wing

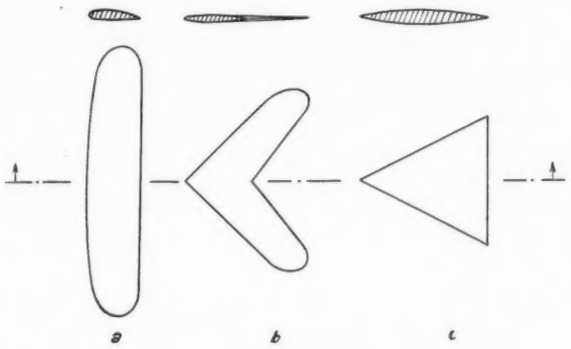


Fig. 1 : Wing shapes of present subsonic and supersonic aircraft.

a Subsonic wing for speeds up to Mach .7
b Swept-wing for speeds up to Mach 1.0
c Delta-wing for speeds up to Mach 1.4

interior. Each of the ducts consists of two Laval tubes. When the air flows into such a duct at supersonic speed, it is first compressed and heated and loses its velocity. In the rear tube the opposite occurs, the air expands and loses its temperature, in the process of which its velocity again increases. If the device could be made to function under ideal conditions, the air leaving the ducts would have an exactly identical temperature, speed and pressure as at the intake. A wing of this kind would discharge the air at the rear in exactly the same condition as it was before entering the ducts. It would not be changed in any way and no energy would be required to move the wing through it.

This ideal condition is not practicable. The air adheres to the metal skin and is dragged along. As a result, it becomes turbulent aft of the wing, and the creation of turbulence obviously absorbs energy. Furthermore, a single, well-defined wing shape can be used only for a specific speed, and it must be adjusted to this speed exactly like a key to a keyhole. Whereas in such a wing the lift drag ratio would many times exceed that of a good wing, at speeds lower by only 5 per cent., it would correspond only to that of conventional wings, and if the speed should decrease by 15 per cent., the drag would probably be so great that a ram jet aircraft would no longer be capable of reverting to normal cruising speed and would therefore be forced to make an emergency landing. An aircraft fitted with such wings would be unable to take off under its own power or fly at a velocity other than that specifically adapted to its design. On the other hand the question arises whether take-off under the aircraft's own power and flight at varying speeds are really indispensable.

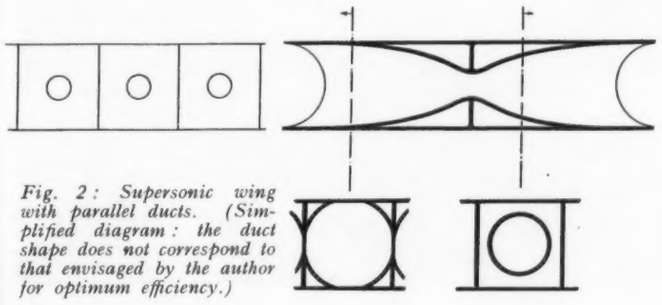


Fig. 2 : Supersonic wing with parallel ducts. (Simplified diagram : the duct shape does not correspond to that envisaged by the author for optimum efficiency.)

At this point one may argue that tests with such wings have not so far been very encouraging. For example, the Mach bow-wave caused by the wing leading edge progresses into the interior of the ducts where it is intensified as in a hollow reflector and blocks the ducts. Also, the rear tubes will not release the air exactly like the forward tubes have taken it in. By coincidence, I made an observation in the gas tunnel at Peenemünde in 1943 which showed me that these disadvantages could be eliminated, although only for a well-defined wing form adapted to a special speed. I do not wish to disclose any further details of this observation, since lack of time prevented me from following it up and since I wish to check it in systematic wind tunnel tests and then apply for a patent. Incidentally, Busemann has observed similar phenomena on the two-dimensional wing duct.[2] Compared with a two-dimensional, the three-dimensional duct so far alluded to largely has the advantage of a somewhat greater tolerance concerning speed variations in the vicinity of the maximum speed.

The drawback of this wing, namely that it is suitable only for a precisely defined speed, is offset by substantial advantages :

First of all, it offers sufficient space for spars, frames and other stiffening members. The space between the ducts can serve as integral fuel tank provided that the fuel which is consumed is replaced with carbon dioxide or nitrogen and not with ordinary air, and provided that adequate heat protection is afforded to the lower wing-skin and the ducts.

Secondly, the lift drag ratio of this wing improves with the quantity of air passing through it, i.e., with increasing thickness, contrary to the conventional wing. This is evident from the following facts :

A device which is heavier than air can stay airborne only by imparting a downwards movement to the air supporting it. In this process, the downward momentum of the air during a certain period of time is equal to the downward momentum which the force of gravity endeavours to impart to the aircraft during the same period. Assuming that W = weight of the device in pounds, this downward impulse during a second amounts to W pound-seconds. If m' = mass of air passing per second (slugs per second) and s = the average downward component of its speed (in feet per second), the following results :

$$W = m's \tag{1}$$

The energy E required to produce this downward component amounts to

$$E = \tfrac{1}{2}\, m's^2 \tag{2}$$

Now if in one case the mass m'_1 is pressed downwards at speed s_1, and in another case the mass m'_2 at a speed s_2, then :

$$W = m'_1\, s_1 = m'_2\, s_2 \tag{3}$$

whereas :

$$E_1 = \tfrac{1}{2}\, m'_1\, s_1^2 \tag{4}$$

and

$$E_2 = \tfrac{1}{2}\, m'_2\, s_2^2 \tag{5}$$

From (4) and (5) there follows that

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Since under identical air density conditions, the quantity of air passing through the ducts increases with the speed of the device, it is obvious that such a wing must work increasingly rationally with growing flying speed (in this case this applies only if it possesses the proper form for the velocity in question).

High-speed flight is limited at the point where the skin temperature would attain an intolerable level. The following formula is applicable :

$$T_v - T_a = Ma^2 \frac{\kappa - 1}{2} T_a \tag{9}$$

T_v stands for the absolute skin temperature on the Kelvin scale ; T_a represents the absolute temperature of the surrounding air, Ma is the Mach number and κ is the average of the adiabatic figure. For air at normal temperature it amounts to 1.4, at higher temperature it becomes somewhat less (for a speed of 2,620 mph, it can be taken as being 1.37). This equation results from Zeuner's Formula for the exit flow velocity from Laval ducts and from the consideration that one could build a *perpetuum mobile* of the second order if things were different.

By using the corresponding values one obtains for the speed of sound (depending upon humidity and temperature conditions) between 620 and 750 mph and for $T_a = 240°$ abs. a skin temperature of $T_v = 288°$ abs., or 15° C. For 3,600 ft/sec. = 2,500 mph, the skin temperature rises to 500° C at an altitude of 65,000 ft., for 4,000 ft/sec. = 2,700 mph it attains 600° C. at an altitude of 82,000 ft., and at 5,000 ft/sec. = 3,400 mph and an altitude of 100,000 ft. it would already amount to 930° C. If the cabin and the cargo compartments were cooled artificially, and if the fuel tanks were protected against heat absorption, one might attain speeds of up to 2,600 mph. In this process the fuel might be used for cooling purposes, and a non-inflammable liquid would have to be used merely for the let-down. At even higher speeds rockets would be more suitable, for these could rise to heights at which the atmosphere is no longer capable of heating a body because practically no air is present.

However, this supersonic wing would be more effective at lower flying levels where the air has a greater density, so that a greater mass of air would flow through a wing of a given frontal area flying at a given speed. But in that case, the dynamic pressure would increase to such an extent that the strength requirements would be excessive. For a speed of about 2,600 mph the optimum flying altitude would be between 80,000 ft. and 90,000 ft.

At subsonic speeds, the L/D ratio of this wing is very unfavourable, but since the greatest portion of the flight would be accomplished with a fuel consumption amounting to only *about 10% of the consumption of a conventional aircraft of identical lifting capacity flying the same distance*, the shortening of the glide path prior to the landing would play no major role. The landing speed could easily be kept as low as 40 mph and could be reduced even further if at low flying speeds the upper wing contour would be moved somewhat forward ; such a development should be aimed at also for stability reasons.

At a speed of 2,600 mph no turbines and compressors would be required, for at this speed the compression in the interior of a ram-jet would reach a value a hundred times greater than the outside pressure. At an altitude of 65,000 ft. this would still amount to nine atmospheres, at 85,000 ft. to four atmospheres and at 100,000 ft. to 2.3 atmospheres. An example of such a tube is illustrated in figure 3.

The intake air flows round the conical body *1*, whereby the flow velocity drops to the speed of sound at the narrowest point *2*. The surrounding duct projects to such an extent that the bow wave emanating from the point of the cone is caught and used for the compression process, whereby it interferes with the shock wave produced by the edge of the tube. It is important that no air should flow over the edge of the tube. Inside the tube the air is compressed and its velocity drops considerably. At point *3* fuel (kerosene) is injected, and owing to the high compression temperature no other form of ignition is required. As a result of the combustion the temperature rises by another 50° to 150° C. Owing to this increase in temperature, the air is exhausted from the Laval duct *4* at a higher speed than at its intake. This produces a reaction force which moves the aircraft forward.

At subsonic speeds the thermal efficiency of such a tube is extremely bad. Even at sonic speed, taking into account the inevitable losses, it would hardly exceed 14%. But at 2,600 mph it would already approach 70% and would therefore be better than that of most Otto-cycle or Diesel engines. Turbines and compressors would merely have a nuisance value.

So far as the fuselage is concerned, it would seem logical to employ the ram tube as the fuselage and the conical body *1* (fig. 3) as the cabin (fig. 4). Thus the fuselage and cabin would play a useful role in the propulsion process instead of hindering it.

The surprisingly low fuel consumption mentioned above, which amounts to only 10% of that of a subsonic aircraft, results from the good L/D ratio and the good efficiency, but a few remarks seem to be useful in this connection :

As pointed out, such a ram-jet aircraft would have to be accelerated to its cruising speed with the help of auxiliary devices. At speeds of more than 2,200 mph only rockets could be used for this purpose. If liquid-fuel rockets were used, they alone would increase

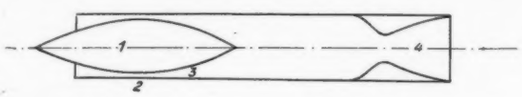


Fig. 3 : Ram-jet design.

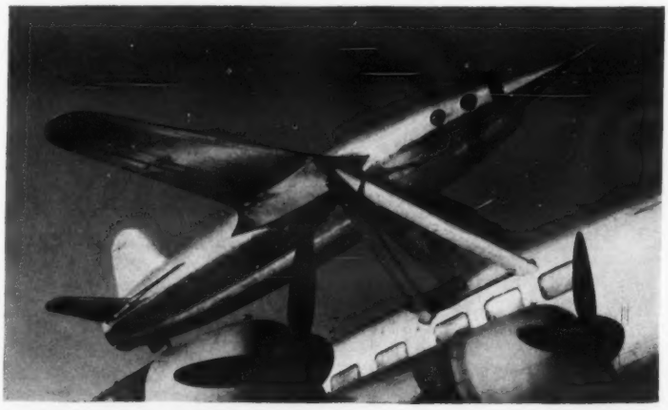
1 Cone
2 Narrowest point (speed of sound)
3 Fuel injection
4 Laval duct

the operating costs twentyfold. For take-off assistance a solid fuel rocket of the type I developed for a large missile in 1944 would have to be employed. It made use of an ammonium-nitrate propulsion charge, resembling gun powder, but which is cheaper than ordinary black powder. In addition, this rocket fuel does not have to be compressed, but can be cast into moulds in which it hardens like glassware or cement. Such a solid fuel rocket is of very simple design. In addition, it can be built largely of materials which themselves burn to dust in the air as soon as the rocket has performed its task. Hence, only the metal nozzles and the instruments to be salvaged (such as control devices) would have to be provided with parachutes and not the entire rocket. The cost of these rockets would amount to only about 2½ cents per pound of total weight, according to the calculations made at the time.

*

If I had to build a ram-jet aircraft, it would look something like the one sketched in Fig. 5. The cabin *1* is surrounded by a sleeve *2*. The air, displaced by the tip of the cone and compressed, flows into the combustion chamber *3* and is exhausted into the atmosphere through the Laval duct *4*. In order to extend the insufficient speed

Fig. 4 : The first piloted ram-jet aircraft is the French Leduc 010 experimental type, two of which were built. It is carried aleft by a four-engined "Languedoc" and accelerated to its minimum speed. Pilot and observer are accommodated in the conical body within the outside duct, through which the air stream passes freely ; visibility is provided by lateral windows in the cabin wall and in the outside duct. The first flight under the aircraft's own power (at subsonic speed) took place on April 21st, 1949.



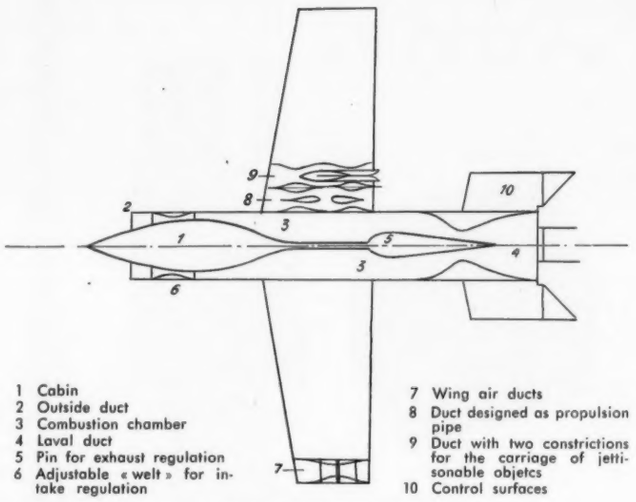

1 Cabin
2 Outside duct
3 Combustion chamber
4 Laval duct
5 Pin for exhaust regulation
6 Adjustable « welt » for intake regulation
7 Wing air ducts
8 Duct designed as propulsion pipe
9 Duct with two constrictions for the carriage of jettisonable objetcs
10 Control surfaces

Fig. 5 : Ram-jet aircraft proposed by the author

range, I would fit a controllable regulating pin *5* to the Laval duct and an adjustable " welt " *6* for the intake opening. By this means the duct conditions could be adapted to the speed to the extent that the aircraft could fly in a speed range between 2,600 ft./sec. = 1,800 m.p.h. and 3,900 ft./sec. = 2,700 m.p.h. under its own power. The result would be an economy in the expensive fuel consumption for take-off and acceleration. [3] True, the aircraft would reach the excessively low fuel consumption mentioned above only at a speed of 2,600 m.p.h.

The wings might feature simple ducts as in *7*. But, as in *8*, these ducts could also serve as ram-jets. In a commercial transport aircraft I would not use this design, however, in order to avoid an increase in friction and fuel consumption. In a military aircraft this idea might be considered. In addition, conical jettisonable objects (such as bombs) could be housed in such ducts featuring two constrictions (as in *9*) without substantially interfering with the air stream.

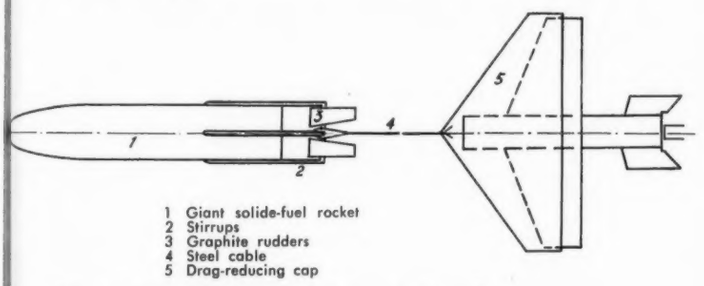


Fig. 6 : Take-off arrangement of ram-jet aircraft

The control surfaces *10* I would either design according to the suggestion of Busemann by using two plates between which a two-dimensional flow would arise, or I would use single plates. The better solution would have to be determined through investigations in the gas tunnel.

Fig. *6* shows the rocket aircraft unit during ascent. *1* is a large ammonium-nitrate rocket. It carries two stirrups *2*. Suspended from the latter are four graphite rudders *3* and a steel cable *4*. The arrangement of graphite rudders is essential in order to counteract the rotation occurring near sonic speed. This arrangement is not as primitive as it would appear at first glance, for the rocket has four nozzles exhausting into the space between the rudders. Hence, the rudders are situated between the gas jets.

The steel cable *4* should not be too short, namely something between 200 ft. and 500 ft. Prior to take-off it is inserted into the main body *1* through a narrow aperture and its end is retained in a kind of vise. When the aircraft reaches a speed at which it can fly under its own power, this vise releases the end of the cable, whereupon the rocket travels ahead of the aircraft until its charge is exhausted ; the rocket housing then burns up to a great extent.

Also suspended to the steel cable *4* is a cap *5* which during the ascent covers the aircraft and aids in reducing air resistance. Between aircraft and cap there may be inserted a parachute, suspended on which the cap, steel cable and incombustible rocket components may land. Should the rocket be disconnected over the sea, the cap alone would suffice to break the drop. Airtight compartments may be built into the cap, enabling it to float and to be picked up by boat. In that case also the rocket housing may be made of metal and salvaged for further use.

An aircraft of this kind need not carry a crew but could be controlled by radio. In this event it could be of relatively small size. Should it be designed for the carriage of passengers, it would have to be of large dimensions in order to make optimum use of the cabin space. The pilot would naturally occupy a seated or prone position in the very nose of the aircraft to provide him with forward vision and enable him to survey the landing site. Besides the cabin, the space between the outer sleeve and the Laval duct could also be used to carry useful loads, for fuel sufficient for a flight to the Antipodes could be stored in the wing interior alone.

During take-off and acceleration the compression shocks in the sonic range would have little effect on the aircraft. The aircraft would be held positively at its foremost point and therefore would be as stable as it could possibly be. In addition, it would fly in the wake and jet exhaust of the rocket. The outside air in this region is turbulent and unhomogeneous, so that no compression shocks of critical value could occur. The rocket would be guided successfully through the sonic range in a similar way as the V-2 was during the war by means of gyros and jet-rudders.

*

The one aspect of these proposals which has been most sharply criticised is that of attaching the rocket ahead of the aircraft by means of a steel cable, instead of having the aircraft propelled by the rocket. In my opinion these criticisms are not justified.

First of all, the transition through the sonic range would be much more difficult, if not impossible, if thrust-rockets were employed.

Secondly, the steel cable take-off would require nothing but a readily sealed aperture of 5/8 in. diameter in the nose of the cabin. On the other hand, if a propulsion rocket were employed to start the aircraft, this would result in a variety of projections, cracks and joints which would have a disagreeable effect at supersonic speeds. The people who collaborated in the development of the V-2 probably have a lot to say on this point.

Thirdly, the device under consideration would be used largely for passenger transportation and at the present time there are very few people who would be ready to take a seat in a rocket, for comprehensible reasons. A passenger aircraft must not only be secure but must also *look safe*. Furthermore, the noise of a large, burning rocket at such proximity would probably worry many a passenger.

Fourth, the rocket initially rises vertically but changes over to a horizontal trajectory at an altitude of something over 65,000 ft. The steel cable, however, lies horizontally on the ground ; hence, the aircraft describes a curve bent at the top, initially flying horizontally and at a low rate of acceleration. This contributes to the comfort of the passenger.

In conclusion a few remarks concerning range seem to be indicated. An aircraft of the type proposed could be employed only for stages exceeding 250 miles. Anybody who would be in such a terrible hurry as to wish to cover smaller distances at such speeds would do better simply to equip the auxiliary rocket with a cabin and a wing, or else to hitch it to a glider. On the other hand, no upper range limit can be set, for this aircraft uses so little fuel and can carry such large amounts of it as to enable it to fly non-stop to the Antipodes in less than five hours.

[3] Perhaps it will be possible to reduce the cost of rocket take-off by giving the unit an initial speed already prior to igniting the rocket, by hitching it to a giant helicopter raising it into the air at a speed of 300 ft./sec. or 600 ft./sec., after which it would be uncoupled ; this would belong to a remote future, whereas the other suggestions submitted seem to be of a more topical nature.

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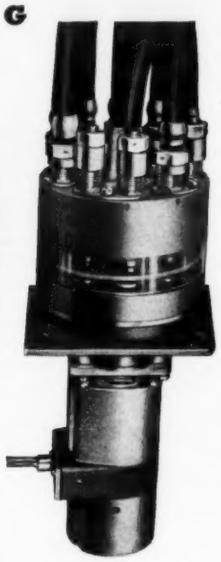

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to indicate, however, that for higher Mach numbers rectangular wing plan forms with sharp leading edges would be as good if not better.

This shows that the wing unit as such has remained an axiom, and all that has been done is to study how it can best be adapted to higher speeds. The fact that even for relatively optimum plan forms the lift drag ratio deteriorates is considered as something immutable, as a result of which one merely endeavours to save what there is to be saved. No advantage has as yet been taken of the elasticity characteristics of the air, and the thickness of the wing dictated by strength considerations is regarded merely as an indispensable nuisance. If it were at all possible, wings would be made as thin as a razor blade.

The same applies to the fuselage. It is regarded from no other angle than in the case of the subsonic aircraft, and it is made as slender as possible only to overcome the high drag values. The power plant is accepted as having to consist of a jet pipe, combined with a turbine and a compressor, of sufficient power to lift the aircraft from the ground after a long run and then gradually to increase its speed to a rational cruising figure. In other words, the *subsonic jet aircraft has merely been adapted for use at supersonic speed.* Instead, the principle shown in Fig. 2 could have been applied to the wing. In this design the wing is perforated by parallel ducts which take in the air meeting the leading edge and pass it through the wing

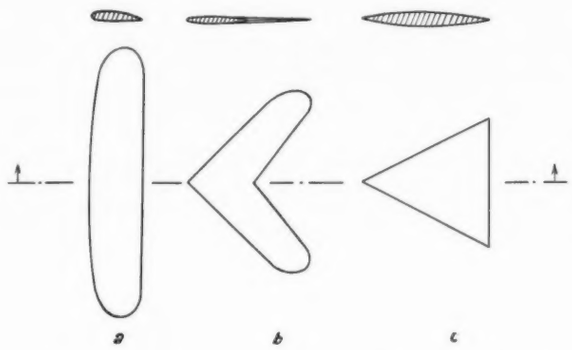

Fig. 1 : Wing shapes of present subsonic and supersonic aircraft.

a Subsonic wing for speeds up to Mach .7
b Swept-wing for speeds up to Mach 1.0
c Delta-wing for speeds up to Mach 1.4

interior. Each of the ducts consists of two Laval tubes. When the air flows into such a duct at supersonic speed, it is first compressed and heated and loses its velocity. In the rear tube the opposite occurs, the air expands and loses its temperature, in the process of which its velocity again increases. If the device could be made to function under ideal conditions, the air leaving the ducts would have an exactly identical temperature, speed and pressure as at the intake. A wing of this kind would discharge the air at the rear in exactly the same condition as it was before entering the ducts. It would not be changed in any way and no energy would be required to move the wing through it.

This ideal condition is not practicable. The air adheres to the metal skin and is dragged along. As a result, it becomes turbulent aft of the wing, and the creation of turbulence obviously absorbs energy. Furthermore, a single, well-defined wing shape can be used only for a specific speed, and it must be adjusted to this speed exactly like a key to a keyhole. Whereas in such a wing the lift drag ratio would many times exceed that of a good wing, at speeds lower by only 5 per cent., it would correspond only to that of conventional wings, and if the speed should decrease by 15 per cent., the drag would probably be so great that a ram jet aircraft would no longer be capable of reverting to normal cruising speed and would therefore be forced to make an emergency landing. An aircraft fitted with such wings would be unable to take off under its own power or fly at a velocity other than that specifically adapted to its design. On the other hand the question arises whether take-off under the aircraft's own power and flight at varying speeds are really indispensable.

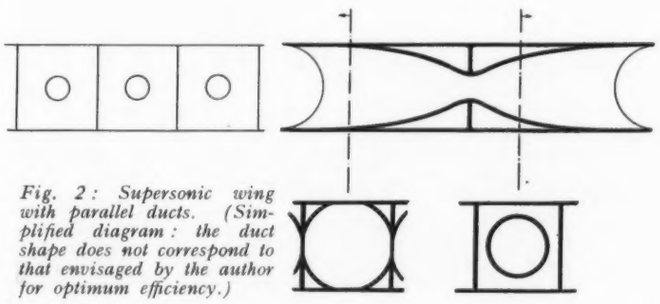

Fig. 2 : Supersonic wing with parallel ducts. (Simplified diagram : the duct shape does not correspond to that envisaged by the author for optimum efficiency.)

At this point one may argue that tests with such wings have not so far been very encouraging. For example, the Mach bow-wave caused by the wing leading edge progresses into the interior of the ducts where it is intensified as in a hollow reflector and blocks the ducts. Also, the rear tubes will not release the air exactly like the forward tubes have taken it in. By coincidence, I made an observation in the gas tunnel at Peenemünde in 1943 which showed me that these disadvantages could be eliminated, although only for a well-defined wing form adapted to a special speed. I do not wish to disclose any further details of this observation, since lack of time prevented me from following it up and since I wish to check it in systematic wind tunnel tests and then apply for a patent. Incidentally, Busemann has observed similar phenomena on the two-dimensional wing duct.[2] Compared with a two-dimensional, the three-dimensional duct so far alluded to largely has the advantage of a somewhat greater tolerance concerning speed variations in the vicinity of the maximum speed.

The drawback of this wing, namely that it is suitable only for a precisely defined speed, is offset by substantial advantages :

First of all, it offers sufficient space for spars, frames and other stiffening members. The space between the ducts can serve as integral fuel tank provided that the fuel which is consumed is replaced with carbon dioxide or nitrogen and not with ordinary air, and provided that adequate heat protection is afforded to the lower wing-skin and the ducts.

Secondly, the lift drag ratio of this wing improves with the quantity of air passing through it, i.e., with increasing thickness, contrary to the conventional wing. This is evident from the following facts :

A device which is heavier than air can stay airborne only by imparting a downwards movement to the air supporting it. In this process, the downward momentum of the air during a certain period of time is equal to the downward momentum which the force of gravity endeavours to impart to the aircraft during the same period. Assuming that W = weight of the device in pounds, this downward impulse during a second amounts to W pound-seconds. If m' = mass of air passing per second (slugs per second) and s = the average downward component of its speed (in feet per second), the following results :

$$W = m's \tag{1}$$

The energy E required to produce this downward component amounts to

$$E = \tfrac{1}{2}\, m's^2 \tag{2}$$

Now if in one case the mass m'_1 is pressed downwards at speed s_1, and in another case the mass m'_2 at a speed s_2, then :

$$W = m'_1\, s_1 = m'_2\, s_2 \tag{3}$$

whereas :

$$E_1 = \tfrac{1}{2}\, m'_1\, s_1^2 \tag{4}$$

and

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However, this supersonic wing would be more effective at lower flying levels where the air has a greater density, so that a greater mass of air would flow through a wing of a given frontal area flying at a given speed. But in that case, the dynamic pressure would increase to such an extent that the strength requirements would be excessive. For a speed of about 2,600 mph the optimum flying altitude would be between 80,000 ft. and 90,000 ft.

At subsonic speeds, the L/D ratio of this wing is very unfavourable, but since the greatest portion of the flight would be accomplished with a fuel consumption amounting to only *about 10% of the consumption of a conventional aircraft of identical lifting capacity flying the same distance*, the shortening of the glide path prior to the landing would play no major role. The landing speed could easily be kept as low as 40 mph and could be reduced even further if at low flying speeds the upper wing contour would be moved somewhat forward; such a development should be aimed at also for stability reasons.

At a speed of 2,600 mph no turbines and compressors would be required, for at this speed the compression in the interior of a ram-jet would reach a value a hundred times greater than the outside pressure. At an altitude of 65,000 ft. this would still amount to nine atmospheres, at 85,000 ft. to four atmospheres and at 100,000 ft. to 2.3 atmospheres. An example of such a tube is illustrated in figure 3.

The intake air flows round the conical body *1*, whereby the flow velocity drops to the speed of sound at the narrowest point *2*. The surrounding duct projects to such an extent that the bow wave emanating from the point of the cone is caught and used for the compression process, whereby it interferes with the shock wave produced by the edge of the tube. It is important that no air should flow over the edge of the tube. Inside the tube the air is compressed and its velocity drops considerably. At point *3* fuel (kerosene) is injected, and owing to the high compression temperature no other form of ignition is required. As a result of the combustion the temperature rises by another 50° to 150° C. Owing to this increase in temperature, the air is exhausted from the Laval duct *4* at a higher speed than at its intake. This produces a reaction force which moves the aircraft forward.

At subsonic speeds the thermal efficiency of such a tube is extremely bad. Even at sonic speed, taking into account the inevitable losses, it would hardly exceed 14%. But at 2,600 mph it would already approach 70% and would therefore be better than that of most Otto-cycle or Diesel engines. Turbines and compressors would merely have a nuisance value.

So far as the fuselage is concerned, it would seem logical to employ the ram tube as the fuselage and the conical body *1* (fig. 3) as the cabin (fig. 4). Thus the fuselage and cabin would play a useful role in the propulsion process instead of hindering it.

The surprisingly low fuel consumption mentioned above, which amounts to only 10% of that of a subsonic aircraft, results from the good L/D ratio and the good efficiency, but a few remarks seem to be useful in this connection :

As pointed out, such a ram-jet aircraft would have to be accelerated to its cruising speed with the help of auxiliary devices. At speeds of more than 2,200 mph only rockets could be used for this purpose. If liquid-fuel rockets were used, they alone would increase

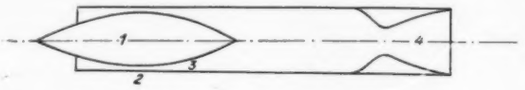


Fig. 3 : Ram-jet design.

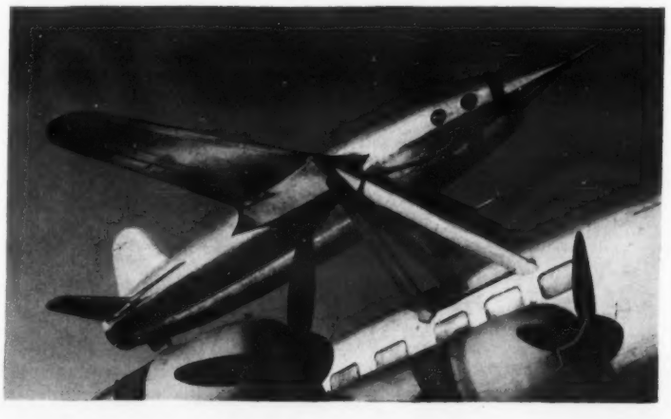
1 Cone
2 Narrowest point (speed of sound)
3 Fuel injection
4 Laval duct

the operating costs twentyfold. For take-off assistance a solid fuel rocket of the type I developed for a large missile in 1944 would have to be employed. It made use of an ammonium-nitrate propulsion charge, resembling gun powder, but which is cheaper than ordinary black powder. In addition, this rocket fuel does not have to be compressed, but can be cast into moulds in which it hardens like glassware or cement. Such a solid fuel rocket is of very simple design. In addition, it can be built largely of materials which themselves burn to dust in the air as soon as the rocket has performed its task. Hence, only the metal nozzles and the instruments to be salvaged (such as control devices) would have to be provided with parachutes and not the entire rocket. The cost of these rockets would amount to only about 2½ cents per pound of total weight, according to the calculations made at the time.

*

If I had to build a ram-jet aircraft, it would look something like the one sketched in Fig. 5. The cabin *1* is surrounded by a sleeve *2*. The air, displaced by the tip of the cone and compressed, flows into the combustion chamber *3* and is exhausted into the atmosphere through the Laval duct *4*. In order to extend the insufficient speed

Fig. 4 : The first piloted ram-jet aircraft is the French Leduc 010 experimental type, two of which were built. It is carried aleft by a four-engined "Languedoc" and accelerated to its minimum speed. Pilot and observer are accommodated in the conical body within the outside duct, through which the air stream passes freely ; visibility is provided by lateral windows in the cabin wall and in the outside duct. The first flight under the aircraft's own power (at subsonic speed) took place on April 21st, 1949.



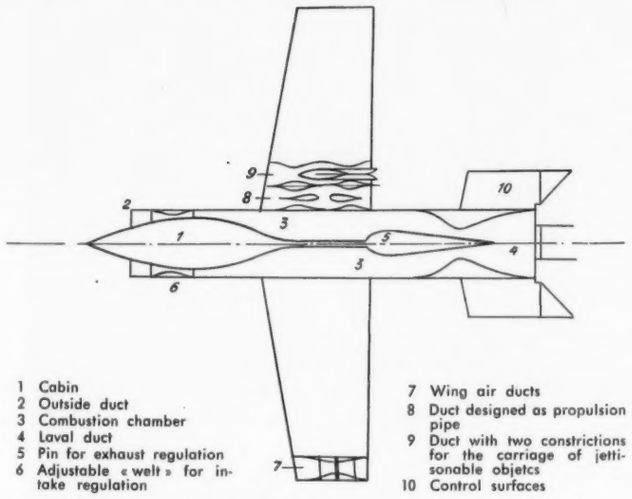

1 Cabin
2 Outside duct
3 Combustion chamber
4 Laval duct
5 Pin for exhaust regulation
6 Adjustable « welt » for intake regulation
7 Wing air ducts
8 Duct designed as propulsion pipe
9 Duct with two constrictions for the carriage of jettisonable objetcs
10 Control surfaces

Fig. 5 : Ram-jet aircraft proposed by the author

range, I would fit a controllable regulating pin *5* to the Laval duct and an adjustable " welt " *6* for the intake opening. By this means the duct conditions could be adapted to the speed to the extent that the aircraft could fly in a speed range between 2,600 ft./sec. = 1,800 m.p.h. and 3,900 ft./sec. = 2,700 m.p.h. under its own power. The result would be an economy in the expensive fuel consumption for take-off and acceleration. [3] True, the aircraft would reach the excessively low fuel consumption mentioned above only at a speed of 2,600 m.p.h.

The wings might feature simple ducts as in *7*. But, as in *8*, these ducts could also serve as ram-jets. In a commercial transport aircraft I would not use this design, however, in order to avoid an increase in friction and fuel consumption. In a military aircraft this idea might be considered. In addition, conical jettisonable objects (such as bombs) could be housed in such ducts featuring two constrictions (as in *9*) without substantially interfering with the air stream.

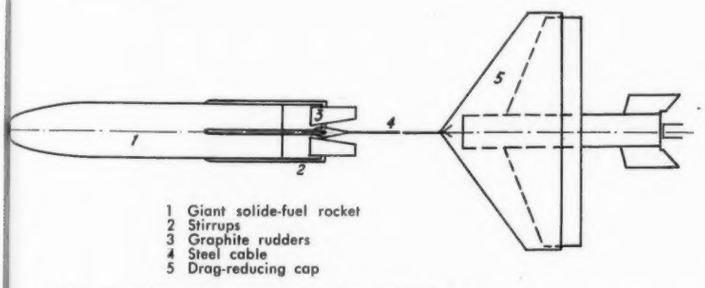


Fig. 6 : Take-off arrangement of ram-jet aircraft

The control surfaces *10* I would either design according to the suggestion of Busemann by using two plates between which a two-dimensional flow would arise, or I would use single plates. The better solution would have to be determined through investigations in the gas tunnel.

Fig. *6* shows the rocket aircraft unit during ascent. *1* is a large ammonium-nitrate rocket. It carries two stirrups *2*. Suspended from the latter are four graphite rudders *3* and a steel cable *4*. The arrangement of graphite rudders is essential in order to counteract the rotation occurring near sonic speed. This arrangement is not as primitive as it would appear at first glance, for the rocket has four nozzles exhausting into the space between the rudders. Hence, the rudders are situated between the gas jets.

The steel cable *4* should not be too short, namely something between 200 ft. and 500 ft. Prior to take-off it is inserted into the main body *1* through a narrow aperture and its end is retained in a kind of vise. When the aircraft reaches a speed at which it can fly under its own power, this vise releases the end of the cable, whereupon the rocket travels ahead of the aircraft until its charge is exhausted ; the rocket housing then burns up to a great extent.

Also suspended to the steel cable *4* is a cap *5* which during the ascent covers the aircraft and aids in reducing air resistance. Between aircraft and cap there may be inserted a parachute, suspended on which the cap, steel cable and incombustible rocket components may land. Should the rocket be disconnected over the sea, the cap alone would suffice to break the drop. Airtight compartments may be built into the cap, enabling it to float and to be picked up by boat. In that case also the rocket housing may be made of metal and salvaged for further use.

An aircraft of this kind need not carry a crew but could be controlled by radio. In this event it could be of relatively small size. Should it be designed for the carriage of passengers, it would have to be of large dimensions in order to make optimum use of the cabin space. The pilot would naturally occupy a seated or prone position in the very nose of the aircraft to provide him with forward vision and enable him to survey the landing site. Besides the cabin, the space between the outer sleeve and the Laval duct could also be used to carry useful loads, for fuel sufficient for a flight to the Antipodes could be stored in the wing interior alone.

During take-off and acceleration the compression shocks in the sonic range would have little effect on the aircraft. The aircraft would be held positively at its foremost point and therefore would be as stable as it could possibly be. In addition, it would fly in the wake and jet exhaust of the rocket. The outside air in this region is turbulent and unhomogeneous, so that no compression shocks of critical value could occur. The rocket would be guided successfully through the sonic range in a similar way as the V-2 was during the war by means of gyros and jet-rudders.

*

The one aspect of these proposals which has been most sharply criticised is that of attaching the rocket ahead of the aircraft by means of a steel cable, instead of having the aircraft propelled by the rocket. In my opinion these criticisms are not justified.

First of all, the transition through the sonic range would be much more difficult, if not impossible, if thrust-rockets were employed.

Secondly, the steel cable take-off would require nothing but a readily sealed aperture of 5/8 in. diameter in the nose of the cabin. On the other hand, if a propulsion rocket were employed to start the aircraft, this would result in a variety of projections, cracks and joints which would have a disagreeable effect at supersonic speeds. The people who collaborated in the development of the V-2 probably have a lot to say on this point.

Thirdly, the device under consideration would be used largely for passenger transportation and at the present time there are very few people who would be ready to take a seat in a rocket, for comprehensible reasons. A passenger aircraft must not only be secure but must also *look safe*. Furthermore, the noise of a large, burning rocket at such proximity would probably worry many a passenger.

Fourth, the rocket initially rises vertically but changes over to a horizontal trajectory at an altitude of something over 65,000 ft. The steel cable, however, lies horizontally on the ground ; hence, the aircraft describes a curve bent at the top, initially flying horizontally and at a low rate of acceleration. This contributes to the comfort of the passenger.

In conclusion a few remarks concerning range seem to be indicated. An aircraft of the type proposed could be employed only for stages exceeding 250 miles. Anybody who would be in such a terrible hurry as to wish to cover smaller distances at such speeds would do better simply to equip the auxiliary rocket with a cabin and a wing, or else to hitch it to a glider. On the other hand, no upper range limit can be set, for this aircraft uses so little fuel and can carry such large amounts of it as to enable it to fly non-stop to the Antipodes in less than five hours.

[3] Perhaps it will be possible to reduce the cost of rocket take-off by giving the unit an initial speed already prior to igniting the rocket, by hitching it to a giant helicopter raising it into the air at a speed of 300 ft./sec. or 600 ft./sec., after which it would be uncoupled ; this would belong to a remote future, whereas the other suggestions submitted seem to be of a more topical nature.

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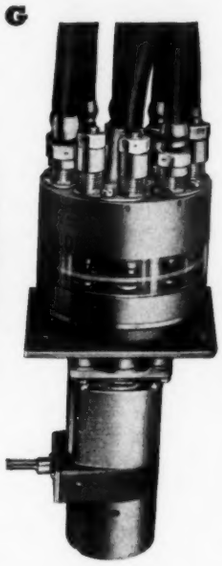

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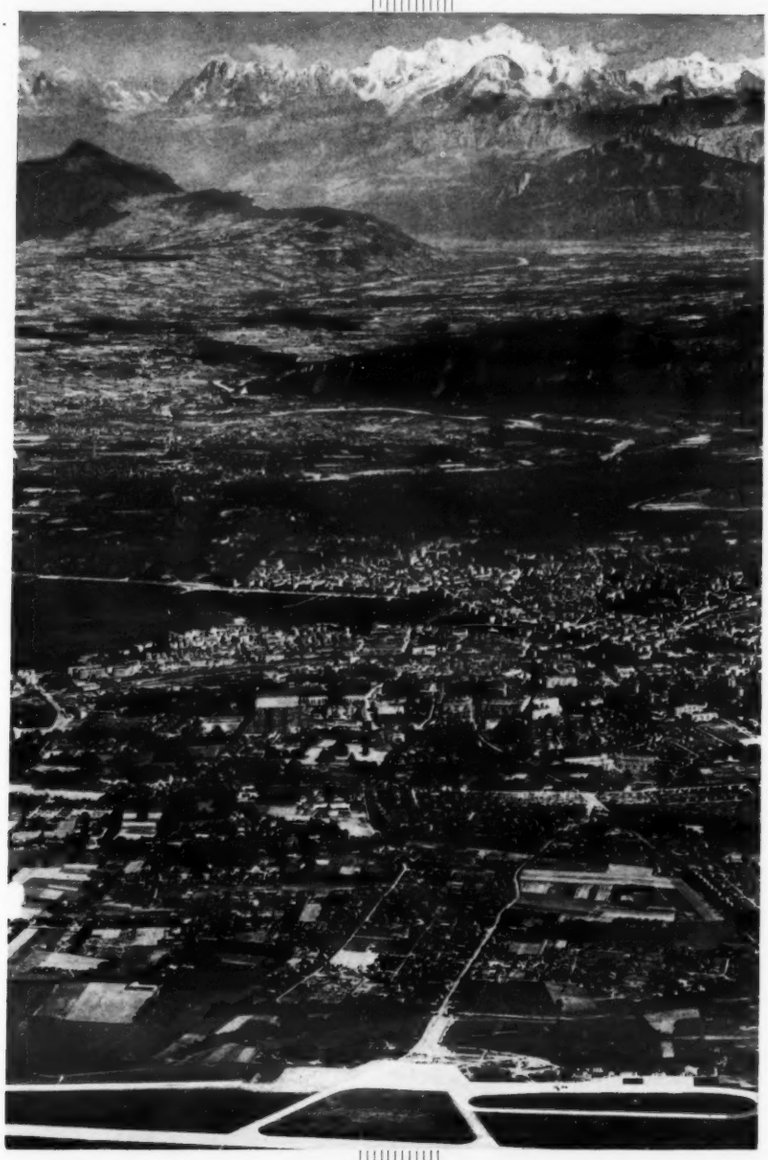

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